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AMERICAN MACHINIST

November 29, 1939

Keeping Up With Aircraft Orders
—A Douglas inspector checks a press-made part as handwork gives way to machine production to meet increased aircraft orders (page 988)

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ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Lapping for Final Finish

A process known since the first lapidary polished jewels for his king lends itself to the needs of modern industry. But there is still much to be learned about it

By H. J. WILLS
Engineer, The Carborundum Company

LAPPING is a final operation which has four chief purposes:

1. To secure great accuracy of dimension.
2. To correct minor imperfections of shape.
3. To provide a fine surface.
4. To provide a fit between two surfaces.

It is frequently confused with other operations to which it has superficial resemblance. Thus it is not uncommon to hear disk grinding spoken of as "lapping," probably because some machines for lapping flat surfaces bear a remote resemblance to some disk grinders.

Disk grinding is essentially a material removing operation. Lapping is also a material removing operation, but not an economical one when large amounts must be removed. A surface to be lapped should, therefore, be first carefully ground, usually to within 0.0005 in. at the most, although in few cases, where a comparatively large amount of inaccuracy must be corrected, as much as 0.001 in. may be removed.

Nor are polishing or buffing operations the same as lapping. Lapping is never used for finish alone. Both polishing and buffing are used solely to get a desired appearance, or optical effect. They are not used for correcting dimension or shape.

The life of moving parts, and even of gages which are subject to wear from friction, is greatly increased by having their surfaces free from "hills and valleys." The greater the percentage of bearing area established by lapping, the longer the surface will last in use.

Also, where a fit between two parts must be able to sustain high liquid or gas pressures without leakage, it is essential that a large proportion of the two bearing surfaces be in close contact throughout their lengths. This calls for great accuracy as to straightness, flatness or roundness which can be secured only by lapping.

Hardened steel gears are lapped to remove cutter marks, to correct imperfections in profile and spacing and to remedy distortion caused by heat-treating. Worm gears require lapping to remove chatter marks, grain marks, and to reduce to a minimum the sliding friction when the parts are in operation. Gears and worms which have been rejected because of surface imperfections can frequently be reclaimed by lapping.

Lapping has many uses in the toolroom: for finishing gages, dies and molds, and for sharpening Stellite and tungsten carbide cutting tools.

Tungsten carbide tools are so brittle that unless the cutting edge is sharp, clean and free from chips the life of the tool will be shorter than it need be. Hand honing is likely to round the cutting edge. Lapping will maintain the necessary square and sharp edge. Lapped tungsten-carbide tools give on the average as much as 100 per cent greater production per grind, when used for fine finishing cuts or on materials that have a high abrasive action.

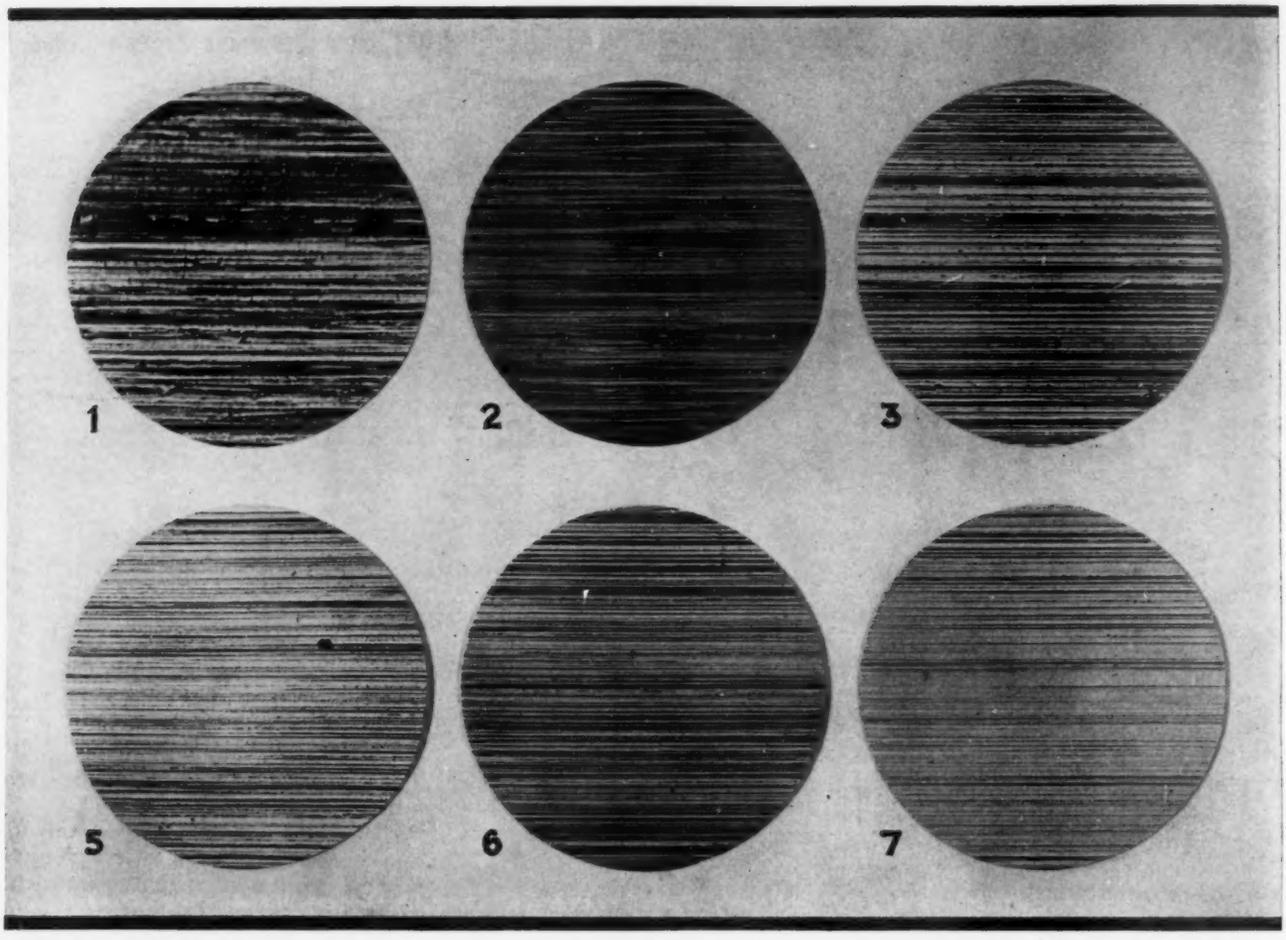
Specific suggestions for performing the lapping operations mentioned above will be given in later articles in this series.

Until recently, lapping was done with a soft metal lap into which was rolled an abrasive such as diamond dust, silicon carbide or one of the natural abrasives. The metal lap served much the same purpose as the bond in a grinding wheel.

In the more effective modern practice the abrasive is embodied in a suitable carrying vehicle and allowed to roll between the lap and the work.

In this method it is essential to select the material of the lap with care, considering the material of which the work is made. Strange as it may seem, in this process the greatest amount of material is removed from the harder of the two parts. Therefore, the lap must be the softer. The reason for this is that in either very soft or very porous laps, the abrasive grains are held temporarily stationary by being imbedded in the lap. Since their position is fixed in respect to the lap, but moving with respect to the work, they cut the work. Thus it is easy to see that the material of which laps are made has a great influence on the speed, accuracy and finish of the work.

The harder the lap the slower the cut, the greater the accuracy, the duller the finish and the more rapid the wear on the lap. The porosity of



These steel specimens from ball bearing raceways illustrate the importance of finishing with the proper abrasive grain. The microscopic sections are all of the same surface finished as follows: (1) ground with 120-grit grinding wheel; (2) after lapping with silicon carbide, 320 grit, wood lap. The surface is torn and has wide valleys and ridges; (3) lapped with wrong kind of aluminum oxide, 150 grit, wood lap. Surface is badly torn; (4) finished with 120 grit aluminum oxide cloth; (5) lapped with aluminum oxide cloth, 120 grit, and finished with 220 grit aluminum oxide grain, dry, leather lap. Time: ten seconds. Higher finish conceals imperfections; (6) lapped with aluminum oxide, 150 grit, oil compound, wood lap. Time: three seconds. Not

the lap also affects the work. Open-grained cast iron will work faster than dense cast iron or steel. For certain jobs laps are also made of the softer metals or even of wood. Selection of lap material will be discussed and recommendations made when describing specific lapping jobs.

The abrasives most commonly used are silicon carbide, aluminum oxide and garnet. Silicon carbide is used for lapping hardened metals, especially gears. Aluminum oxide is used for softer metals. Garnet is recommended for all sizes of reduction gears and for non-ferrous valves. Abrasives should be about the same hardness as the work.

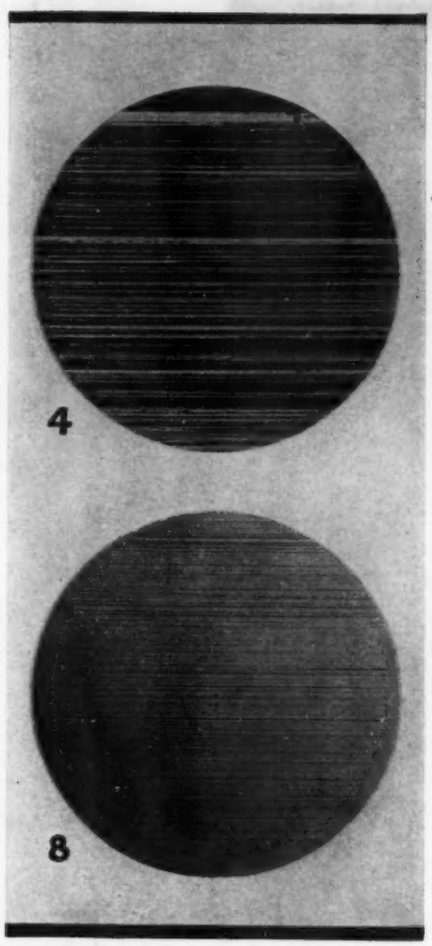
Abrasives for lapping range from 60 down to 1,000 grit. The latter is a very fine powder which is used for fine, soft lapping.

The abrasives are usually held in a vehicle, sometimes called a "lubricant" which to some extent controls the action of the abrasive and prevents scoring or galling of the work. Vehicles range from alcohol or water through various oils to heavy bodied greases. The mixtures of abrasive grain and vehicle are often made in the shop, more or less by rule of thumb. Ready mixed compounds can, however, be purchased which have the advantage of being more uniform, and if carefully selected, better fitted to the particular job in hand.

The speed and quality of a lapping operation depend upon several variables, such as: material to be lapped; material of the lap; type of vehicles; type and size of abrasive; pressure on the lap; and the personal skill and even psychology of the operator. Under 800 surface ft. per min., lap speed has little effect, but greater speeds slow up the work decidedly while improving the finish. Pressure of laps against the work also affects both speed and finish. The amount of pressure used is a matter of personal choice, although it is well to remember that high pressure may crush the abrasive grains and score the work if the lap is hard. Higher pressures may be used with softer laps.

Because of these variables, it is not impracticable to make definite recommendations as to the exact combination of abrasive and vehicle to use for a specific job. That can be done effectively only by someone thoroughly versed in lapping practice, and often only after shop tests. The table shown, therefore, should be considered only as an approximate guide.

So while it is not feasible to make recommendations as to the type of vehicle to use for any job, without



so high a finish as No. 5, but a better surface; (7) lapped with aluminum oxide, F grit, soluble oil compound, lead lap. Time: five seconds; (8) lapped with aluminum oxide, 150 grit, grease compound, hard felt lap. Time: four sec. Commercially perfect

knowing all about the surrounding conditions, it is possible to give certain tips which will be useful.

Starting with alcohol, which gives the greatest cut and usually the poorest finish, the cut is decreased and the finish improved as heavier bodied oils or greases are used—other conditions remaining the same, of course.

To be most effective the vehicle used for any job should have these qualities. It should:

1. Be only slightly affected by temperature changes.
2. Hold the abrasive grain in absolute and unchangeable suspension under all conditions.
3. Hold the grain uniformly separated from other grains in all directions.
4. Allow for speed of cut and at the same time prevent deep grain marks.
5. Give a cool cutting action.
6. Be non-corrosive.
7. Not affect operator's skin.
8. Not require the use of an explosive cleaner.

In the chart of lapping recommendations which accompanies this article it will be noticed that the compounds are identified by symbols consisting of a letter and a number. These are to help in selecting the right compound for any job. Thus:

The *R* series, contains a hard abrasive for hardened steels, rolling or sliding action. The *W* series contains a medium hard abrasive for soft steels, rolling action; or, for any metal, sliding action. The *G* series is a medium soft abrasive for rolling or sliding action on soft metals. The *H* series is made of soft abrasives for all soft metals and for certain hard metals.

A recent development is the so-called "lapping plate" used for finishing flat parts. Strictly speaking this is not a lapping operation. However, the end achieved is much the same, and the plates give a flat surface with a high degree of finish. They are made of bonded abrasive in any size, grain and grade of special bond. They can be had for either wet or dry operation.

In the next installment specific instructions will be given for various toolroom lapping operations.

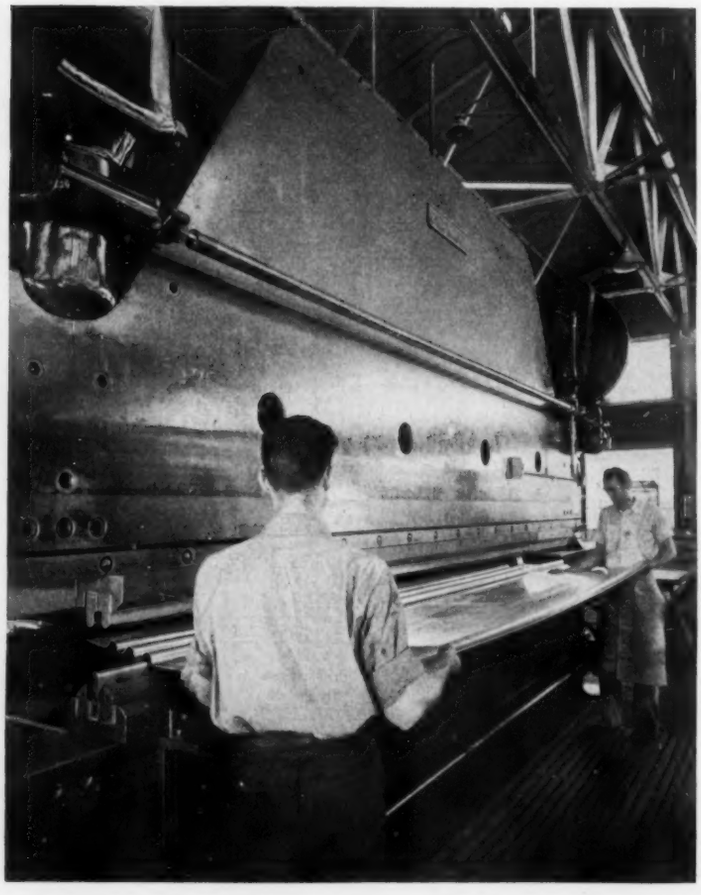
LAPPING RECOMMENDATIONS

USES	Compounds	Abrasive	Approx. Grit	Vehicle	Solvent
Locomotive Bootlegs and Headers	R7 Ex. Coarse	C.	50	G.	W.
Large Steel Valves	R7 Coarse	C.	90	G.	W.
Large Steel Valves, Coarse Gears (Hard)	R7 Medium	C.	150	G.	W.
Small Steel Valves, Fine Gears (Hard)	R7 Fine	C.	220	G.	W.
Spiral Bevel Gears — Truck and Bus	R1 Ex. Coarse	C.	120	O.	K.
Spiral Bevel Gears — Truck and Bus	R1 Coarse	C.	150	O.	K.
Spiral Bevel Gears — Automobile	R1 Medium	C.	F	O.	K.
Hypoid Gears — Large	R1 Fine	C.	FF	O.	K.
Hypoid Gears and Steel Parts and use on Bethel-Player Lapping Machine	R1 Ex. Fine	C.	FFFF	O.	K.
Truing Rubber reclaiming rolls	RR1 Special	C.	60	G.	K.
Spur Gears (Red Wing lapper) — fast cut	R8 Medium	C.	150	G.	K.
Spur Gears (Red Wing lapper) — finish	R8 Fine	C.	220	G.	K.
Large cast steel or cast iron gears	W7 Coarse	A.	90	G.	W.
	W4 Coarse	A.	90	G.	K.
	W5 Coarse	A.	90	G.	K.
Medium size cast steel or cast iron gears and ball bearings	W7 Medium	A.	150	G.	W.
	W4 Medium	A.	150	G.	K.
	W5 Medium	A.	150	G.	K.
	W9 Medium	A.	150	S.O.	W.
Small cast steel or cast iron gears and ball bearings	W7 Fine	A.	F	G.	W.
	W4 Fine	A.	F	G.	K.
	W5 Fine	A.	F	G.	K.
Aircraft Engine Cranks — fast cut	W40 Medium	A.	F	S.O.	W.
Aircraft Engine Cranks — finish	W40 Fine	A.	FFF	S.O.	W.
All large reduction Gears (soft action)	G7 Coarse	G.	150	G.	W.
	G4 Coarse	G.	150	G.	K.
All medium size reduction Gears (soft action)	G7 Medium	G.	220	G.	W.
	G4 Medium	G.	220	G.	K.
All fine reduction gears and non-ferrous valves	G7 Fine	G.	FF	G.	W.
	G4 Fine	G.	FF	G.	K.
Machine Bearings, Molds, General Tool Room Work, General use on Bethel-Player Lapping Machine	H40 Coarse	A.	220	S.O.	W.
	H41 Coarse	A.	220	O.	K.
	H440 Coarse	A.	220	G.	W.
	H40 Medium	A.	320	S.O.	W.
	H41 Medium	A.	320	O.	K.
	H440 Medium	A.	400	G.	W.
	H40 Fine	A.	800	S.O.	W.
	H41 Fine	A.	800	O.	K.
	H440 Fine	A.	600	G.	W.
	H400 Fine	A.	800	S.O.	W.
	R440 Fine	C.	600	G.	W.
High finish on Bethel-Player Machine	A41 Medium	A.	600	O.	K.
Coarse Polishing	H46 Coarse	A.	220	P.	W.
General Polishing	H46 Medium	A.	400	P.	W.
Fine Polishing	H46 Fine	A.	800	P.	W.
Extremely fine and soft lapping	H440 Ex. Fine	A.	1000	G.	W.
Extremely fine and medium soft lapping	W440 Ex. Fine	A.	1000	G.	W.

NOTE: All 400 series compounds are chemically pure and precision controlled.
C.— Silicon Carbide. A.— Aluminum Oxide. G.— Garnet. G.— Grease.
O.— Oil. S.O.— Soluble Oil. P.— Paste. W.— Water. K.— Kerosene.

With a big background of orders, Douglas can use production tools to the fullest extent. Here is a battery of power-driven rotary shears with which trained men accurately profile formed sheet parts

Aircraft

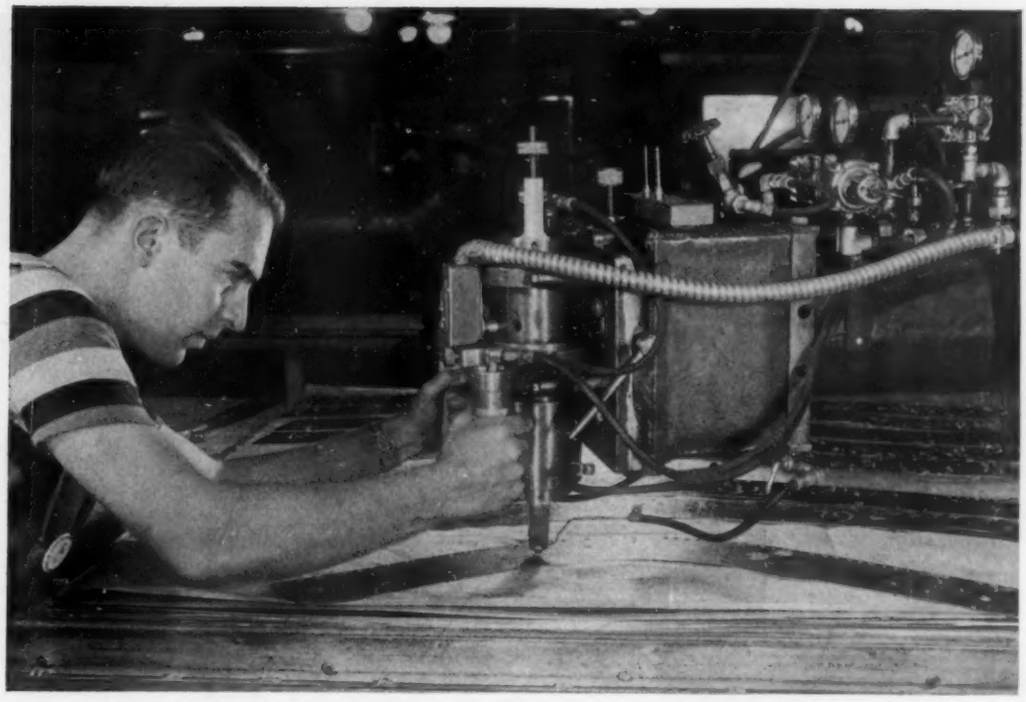


DOUGLAS AIRCRAFT COMPANY now has a backlog of about $50,000,000 in unfilled orders of which a large part is composed of the DC-3 transport. One airline alone operates or has on order a total of more than 70 of these planes.

The Douglas payroll is now up to more than $20,000,000 a year with some 12,000 people working in two plants at El Segundo and Santa Monica. They use the latest equipment and processes. The hydro presses employed in the Douglas plant use their own patented Guerin process by which a rubber blanket is pressed against the male (in some cases female) die to form parts using only half a metal die.

This and other modern metal-working methods are shown in the following picture story.

Many special forms of corrugated metal are produced from flat sheet stock by special dies mounted in a Cincinnati power brake



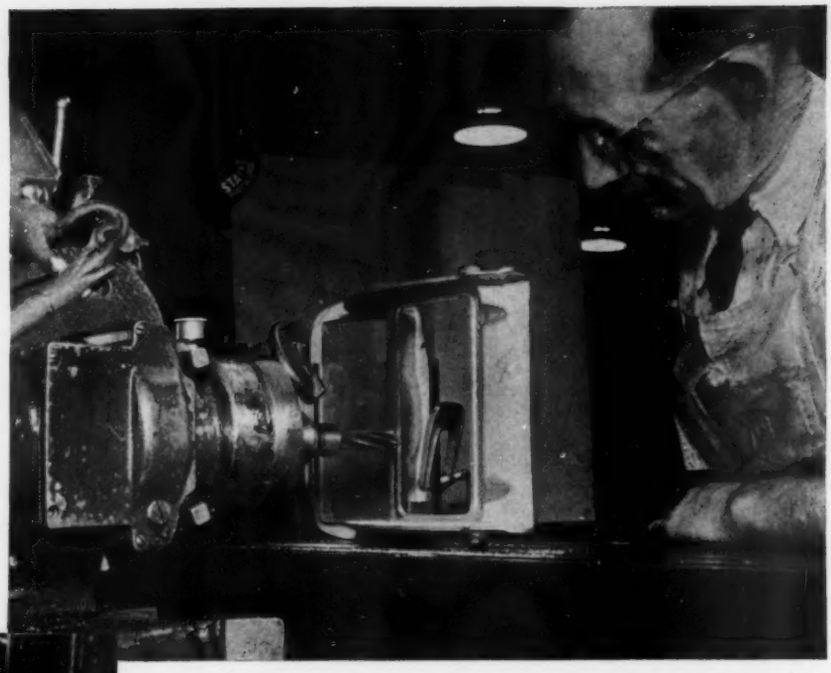
Here is the first step in the manufacture of a fuselage channel for the DC-3 airliner. Rivet and bolt holes are drilled on a special table with a templet clamped to a multi-sheet stock stack

Turns to High Production

This channel has been formed on the hydro press over the die shown in the background. Pins on the die and pin-holes in the part maintain proper alignment. The hydro press uses only a male die against which a thick rubber pad is pressed to complete the forming operation. The channel is now properly relieved to take stringers and drilled for riveting

After all the holes are drilled in the sheet stock, router jigs are clamped in place, and the movable head is used to profile the stock

AIRCRAFT TURNS TO HIGH PRODUCTION



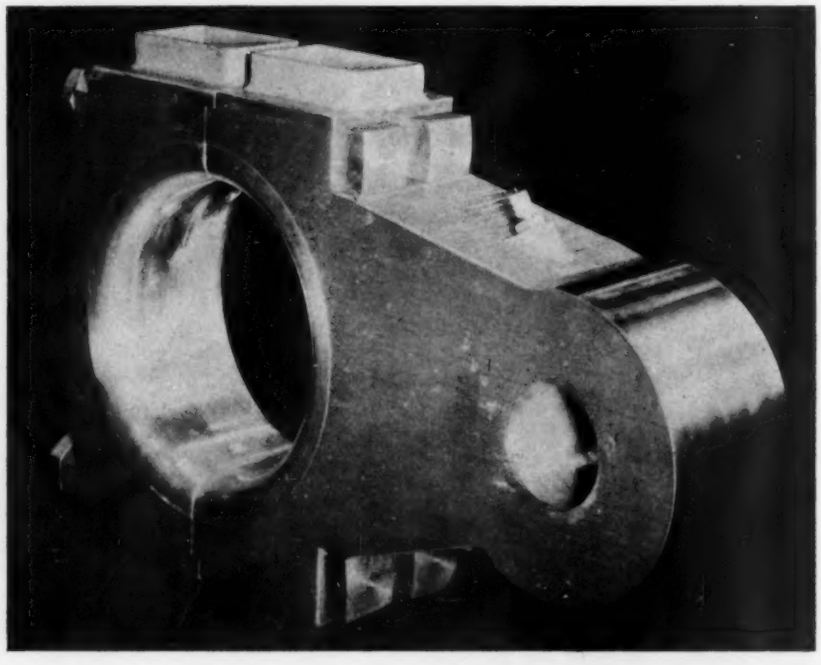
Another part has also been formed and sheared to exact size by means of the hydro press. Again shearing is done by pressing with a rubber pad against the sharp edge portion of the die. Note that the two small holes have been both flanged and sheared. Results are surprisingly uniform and satisfactory. One of the world's largest hydro presses is used for this work

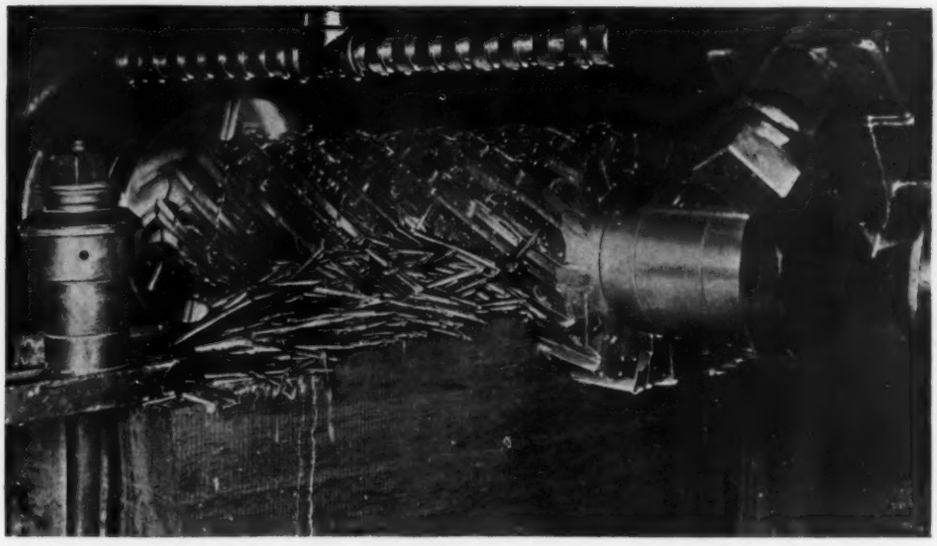
This carbureter air elbow base for use on a military plane is set up for milling the base for a tight fit on the carburetor. Sides of the shaft holes are also milled for operating clearance

Weldings for Forging

IN THE FORGING machines built by the Ajax Manufacturing Company, the pitman and cap transmit power from the crankshaft to the header slide for forming the forging. The pitman is subject to a high compression load during advance stroke and to tension during the pull back.

Breakage of pitmans was experienced until heavy flame-cut steel plates were adopted for this service. With this construction, failures were practically eliminated because of the soundness of the steel plate. Freedom from hard spots, found in machining pitmans of other material is another advantage. Steel plate pitmans and caps for Ajax Forging Machines have been flame-cut in thicknesses from 3⅜ to 9⅞ in. Oil pockets and setscrew bosses or lugs are welded on. The finished pitman and cap illustrated was made from flame-cut steel plates produced by the By-Products Steel Corporation and Lukenweld, Inc.





How Thick a Chip?

What happens when a milling cut is taken? Chips are formed, of course. A study of the cutting action may lead to increased smoothness in the finished surface

By A. L. De LEEUW
Consulting Engineer

AFTER A RATHER prolonged stay abroad, an article, by G. H. Borneman, of the General Electric Company (*AM*—Vol. 82, page 189), attracted my attention. It dealt with a forgotten, or rather a neglected factor in milling, and leads to a number of other considerations not touched upon in that article. Yet these considerations are important for a clear understanding of what happens when a milling cut is taken.

To simplify matters at the start, first consider what happens when the cutter has one tooth only. Fig. 1 shows the cutter in three successive positions. For the sake of illustration, the conditions are much exaggerated.

It is evident that the amount of metal removed during one revolution of this single-tooth cutter is the depth of the cut multipled by the feed, and this again multiplied by the length of the cut. We may neglect this third factor and consider the cross section (feed $\times$ depth) only. Imagine this cross section as a rectangle of which one side is the path described by the point of the tooth of the cutter and the other side is the chip thickness. The amount of metal removed is actually a distorted rectangle, as the parallel lines in the diagram show. To find the chip thickness it is necessary only to determine the length of the path of the tooth.

Simple as this sounds, it is not mathematically correct. Though the error is small as to amount, it is an important one in the practice of milling. If it were strictly true, then the cross section of the metal removed between the positions O_1 and O_3 of the cutter, would be the rectangle *ACHI*, but the figure shows plainly that there are two little triangles (or near triangles) *ABK* left untouched. In all cases one meets in practice, the area of such a triangle is extremely small as compared to the area of the rectangle and may be neglected. However, these triangles are of importance when it comes to the finish of the milled surface.

The path of the milling tooth is not an arc of a circle, as it is the resultant of the circular movement of the cutter tooth and the linear movement of the center of the cutter. Here again, the difference in lengths of the true path and the arc *AL* or *BM* is extremly small in practice and may be neglected. For all practical purposes, then, it may be said that the area of cross section of the chip is the product of the length of the arc described by the point of the tooth multiplied by the chip thickness; so that all that is necessary to find this thickness is to divide the area of the cross section (depth of cut $\times$ feed) by the length of the arc.

The length of this arc is easily found. Cos $S = (R - D) \div R$, in which R is the radius of the cutter and D the depth of cut. The length of the arc is $S/360 \times 2\pi R$. The cross section of the chip is DF, in which F is the feed. The chip thickness is:

$$T = \frac{DF \times 360}{S \times 2R}$$

If S is expressed in radians, then:

$$\frac{DF}{SR} = T$$

That there are a number of teeth in the cutter instead of just one tooth does not affect the result so far obtained, provided that the ends of all teeth are the same distance from the

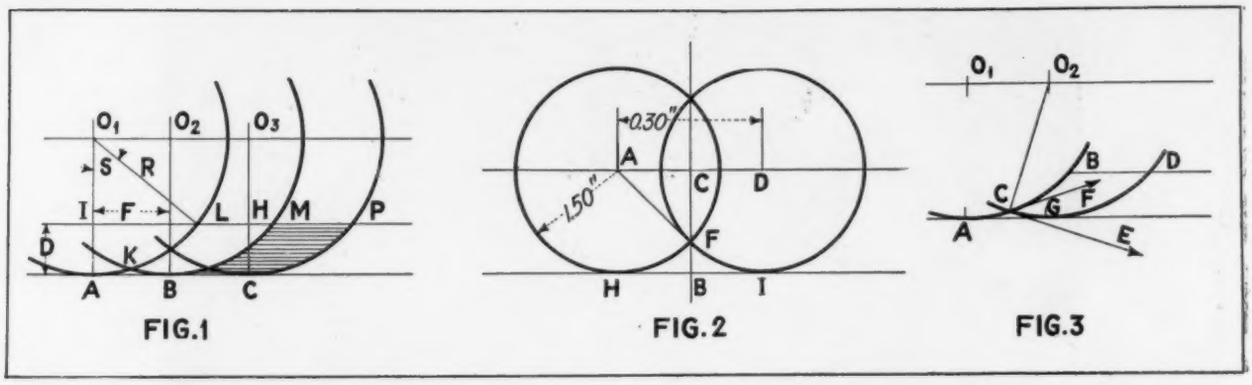


Fig. 1—Metal removed by the tooth of a milling cutter is actually a distorted rectangle, as indicated by the parallel lines in the area **BCMP.** *Fig. 2—Each tooth tends to produce its own level on the work. Other teeth sweep away part of the height of the "hill"* **FHI,** *or revolution mark, caused by each tooth because of the feed between revolutions. Fig. 3—When the teeth of a milling cutter are ground radially there is a reversal of pressure at point* **G,** *tending to cause chatter. Rake on the teeth contributes to smooth cuts*

center of the cutter and that they are evenly spaced. If some of the teeth are shorter than some others, not all of the teeth take the same depth of cut; and if they are not evenly spaced, they do not have the same amount of feed.

On the general principle that absolute perfection is not attainable, we may say that in no case are the teeth evenly spaced, nor all teeth of the same length. There will be one tooth longer than all the others. A number of conditions work together to bring about this defect.

The arbor on which the cutter is mounted when it is being sharpened, has a taper shank. This shank may not have the same centerline as the part on which the cutter is mounted, nor is it necessarily absolutely parallel with it. The spindle of the head in which the arbor is placed has an internal taper about which the same can be said that was said about the arbor.

We meet another set of imperfections when the cutter is mounted on an arbor and this arbor is placed in the taper hole of the spindle of the milling machine. Some of these defects may cancel each other, but such is the natural perversity of inanimate things that, if one does not wish to be disappointed, it is well to consider that all of them work together to produce the maximum error.

Each tooth tends to produce its own level on the finished work, and if the teeth varied much in length and the feed were very large, a number of various levels would be visible. That this is not so in reality is because the differences in length are, after all, very small and the feed per tooth is never more than a few thousandths of an inch.

To show this more clearly, the example in Fig. 2 is used. It is assumed that the cutter is three inches in diameter and that the feed is 0.30 in. per revolution. Then, *BC* and *AF* are 1.50 in., *AD* is 0.30 in., and *AC* is 0.15 in. In the triangle *ACF,* we thus have $CF = 1.492+$ and $BF = 1.500 - 1.492 = 0.008$ in. or less.

It will be seen from Fig. 2 that the height of the "hill" decreases with the diameter of the cutter, and that it increases with the amount of the feed. If a very large feed were taken, the height of the hill would be much increased. However, in that case this height would have been more than the error of cutter and mounting, and other teeth would have swept away some of the height of the revolution mark. The height of this mark never can be more than the amount of error of cutter and mounting, and may be very much less.

The appearance of a piece of finished milled work depends on the number of revolution marks to the inch. If a certain definite cutting speed is given, then the best finish will be produced by using a cutter of the smallest practical diameter. This increases the number of revolution marks per minute, and thus brings them as close together as possible. However, it does something else too. It increases the height of the little hills and, if one wishes to produce the best possible appearance of the finished work, a compromise will be in order.

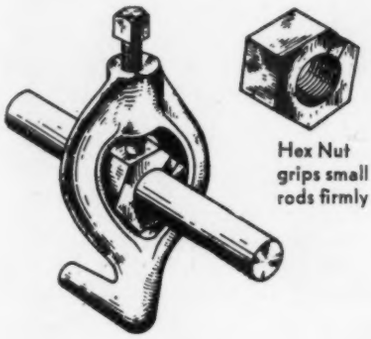
A study of the curve described by the cutter tooth reveals some other things of interest. As cutters formerly were made, and as some of them are still made at the present time, the teeth were radial. The curve *AB* in Fig. 3 is part of the path described by a tooth of the cutter when it took the previous cut. Its center was at O_1 when the tooth had reached the point *B.* Before this same tooth could take another cut, the center had to move to O_2. The arrow *CE* is at right angles to the tooth; it is, in other words, the direction in which the tooth is attacking the metal. The arrow *CF* is a tangent to the curve *AB.* This shows that the angle between the tooth and the metal it is about to attack, is less than a right angle, in other words, that the cut is taken by a tool with negative rake. In the illustration the amount of this negative rake is indicated by the angle *ECF.* This angle is very small in reality, but the fact that there is such an angle at all is of importance when analyzing cutter action.

Everyone realizes that a milling cut is not of an even nature; that it starts with a minimum of metal, that the cut gradually increases in cross section until it reaches a maximum, the chip thickness, and that the cut then diminishes up to the point where the tooth leaves the metal entirely. All of which is true when the depth in cut is less than the radius of the cutter, that is in the great majority of work. The pressure on the work and on the cutter starts with a minimum, increases, and then decreases.

There is a downward pressure at the point *C* and for some distance further on. At some point of the curve *CD* this pressure becomes entirely tangential. This happens at the point *G,* where the center of the cutter is vertically above the finished surface of the work. At this point the pressure is horizontal, and from that point on the pressure on the work will be upward. It is this reversal of the direction of pressure which is one of the main causes of chatter, and it was this consideration, though not the only one, that lead the author to introduce rake on milling cutters in 1908. Rake of the teeth eliminates this reversal of pressure and contributes to the smoothness of the cut.

SHORT CUTS FOR THE SMALL SHOP

A. H. WAYCHOFF



Hex Nut grips small rods firmly

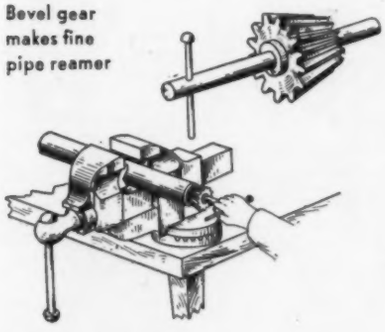
MANY MACHINISTS carry only one lathe dog in their equipment, usually a large one for the larger work. When the time comes to hold a small rod or shaft they have a lot of trouble. To overcome this you can use the dog to hold the smallest work by getting a hex nut that will just slip on the rod and making a cut through one side as shown, using two blades in the saw. Then the rod is slipped in the nut and dog set-screw tightened down on it. This is a satisfactory way of holding small work, and it's a good idea to have several sizes of these nuts in the tool box all the time

Occasional lye bath makes files last longer

GOOD FILES take a lot of use to wear out, but it doesn't take long for them to get slick from filling up. Probably half the files thrown away as dull and useless would give months more service if this simple and inexpensive treatment had been given them occasionally. Just get a length of pipe a little shorter than the longest file and screw a pipe cap on one end. Pour two or three spoonfuls of common lye into the pipe and then fill it with boiling water. Drop the files in and let them soak for an hour or so. Then rinse them in clean cold water and brush them a little with a fiber brush. With ordinary use, files treated this way once a week ought to last twice as long

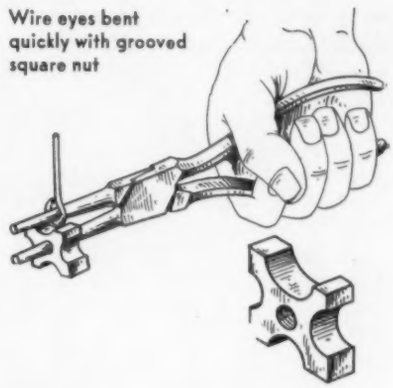
Pin keeps soldering paste handy

SOLDERING PASTE is always handy when carried in a gadget figured out by one electrician. He simply bent a length of steel wire into a U, sharpened the ends, and soldered it to the bottom of the can. Depending on the kind of job he's working on, he wears it on his sleeve, over-all bib, and even on the back of his glove. And when it's not being worn, it can still be set down firmly on any flat surface. There's no reason why it wouldn't be just as handy for mechanics grinding engine valves to carry their grinding compound around this way



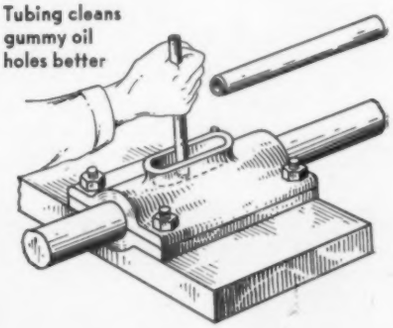
Bevel gear makes fine pipe reamer

SMALL BEVEL GEARS of cut steel can be found in any auto junk yard, and these gears make fine pipe reamers with only a little work. Just grind a cutting edge on each tooth, and force it onto a shaft with a hole through it for a tommy. One of these gadgets will usually handle at least three different sizes of pipe, so two or three would be about all you'd ever need



Wire eyes bent quickly with grooved square nut

A COMMON SQUARE NUT can be converted into one of the handiest tricks ever for bending eyes in lengths of wire. Grooves of different radius are filed in each side, and then the nut slipped over one jaw of a pair of round-nosed pliers. The wire is simply laid across the ground out portion of the nut and the pliers squeezed. Different sized eyes can be obtained just by choosing the right radius groove



Tubing cleans gummy oil holes better

ON EXPOSED BEARINGS gummy dust gets in the oil chamber and settles down in the oil hole. The oiler usually tries to open them up with a piece of wire before oiling, but this is a tedious task and doesn't do a very good job either. One oiler got around the difficulty with no trouble at all. He just took a piece of thin walled seamless tubing about six or eight inches long and beveled off one end like a small hollow punch. The tubing was a size which would just slip down into the oil holes. Then all he had to do was poke the tubing down into the hole, and the gummy stuff was pushed up into it and stayed there. With each oil hole he cleaned, more stuff would get pushed up into the tube, until finally it started coming out the top. Then he just cleaned it out with a rod

Broaching Hits the Mark

MODERN production processes have been applied to the manufacture of rifle parts. Many components lend themselves to broaching.

Past methods of multiple operations on rifle parts have yielded to the simpler, speedier process of broaching. The irregular contours of these parts meant many set-ups and light cuts resembling nothing more than picking away the metal.

Broaching was a logical application for these parts, and its extensive use was predicted in these pages early this year. This prediction has now become a reality. The process has already been applied to the production of many rifle parts, some of which were shown previously (*AM*—Vol. 83 page 902) and some illustrated here. One ordnance factory has installed a battery of 26 standard vertical broaching machines for this purpose.

These are single-slide vertical surface, double-slide vertical surface, and vertical pull-down Oilgear machines equipped with tools and fixtures by the Detroit Broach Company. The previous article described the application of these machines and fixtures to the broaching of sight bases, trigger guards with parallel side surfaces, and one miscellaneous internal part. This present article continues the study, describing the broaching of triggers, trigger guards with offset side surfaces, automatic bolts, and locking lugs.

All internal surfaces are broached on vertical pull-down machines, while external surfaces are broached on single- and double-slide vertical surface machines. The pull-down machines are equipped with automatic tool handling; dual pushbutton control with selector switch for manual, semi-cycle or semi-automatic operation; automatic puller operation; and variable broaching and return speeds. The vertical surface machines have a selector switch for manual, semi-automatic and full-automatic operation; automatic straight in-and-out shuttle-table operation interlocked with tool-slide operation; micrometer stops for precise positioning of the shuttle table and work in broaching position; automatic clamping and unclamping of work; and variable broaching and return speeds.

TRIGGER GUARD

(Offset Side Surfaces)

FIRST OPERATION

MATERIAL: Forged carbon steel.

OPERATION: Finish broach internal oval hole $1\frac{5}{32}$ in. wide by $2\frac{1}{32}$ in. long from a rough pierced hole. Broach two parts per stroke with two tools.

STOCK REMOVED: 0.067 in. maximum on each side.

PRODUCTION: 400 per hr.

TOOLS: Built-up type with solid bar for straight surfaces and sectional inserts for both half-rounds.

FIXTURES: Simple dual-faceplate type with pins for roughly locating each part.

MACHINE: Vertical pull-down broaching machine, 12x30-in. stroke.

CYCLE: Operator roughly locates two parts on fixtures and depresses dual safety control buttons. Tools thread through rifle parts, enter pullers and are automatically pulled down to broach trigger guards. Finished parts are removed and dual safety control is depressed to return tool-slide and tools to loading position. Operator does not handle tools. Cutting speed, 30 ft. per min. Return speed, 80 ft. per min.

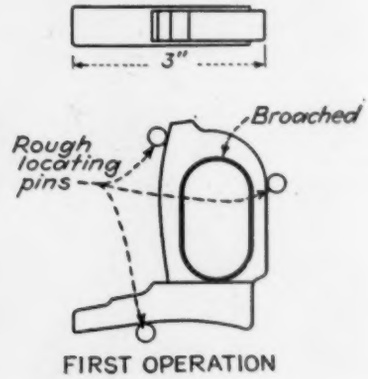
SECOND AND THIRD OPERATIONS

MATERIAL: Forged carbon steel.

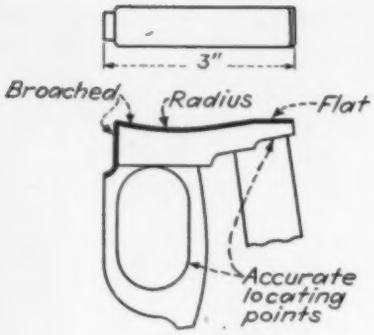
SECOND OPERATION: Finish broach a 12 in. radius, three step surfaces and an end surface from the rough forging. See left-hand tool-slide and fixture.

THIRD OPERATION: Finish broach a 5 in. radius, a flat and an end surface with fillet from the rough forging; right-hand tool and fixture.

STOCK REMOVED: 0.090 in. from each surface.



FIRST OPERATION



THIRD OPERATION

ations are performed on this broaching machine by moving the part finished on the left-hand fixture to the right-hand fixture.

RIFLE BOLT

MATERIAL: Forged carbon steel.

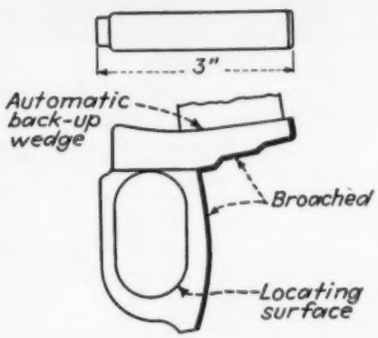
OPERATION: Finish broach the arc and two straight surfaces on one rifle bolt per stroke.

STOCK REMOVED: 0.040 in. from each surface.

PRODUCTION: 200 pieces per hr.

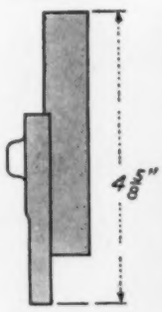
TOOL: Special shear and straight slab form cutter bars with the lower sections arranged to broach the arc surface *A* and the two straight surfaces *B* and *C*, while the upper tools are arranged to broach the arc surfaces *D* and *E*. The tool inserts are assembled into a convenient tool holder which is fastened to the vertical tool-slide.

FIXTURE: Automatic jaw type with spring-loaded lever mechanism



SECOND OPERATION

while a positive pin backs-up the protruding end of the right-hand part). Tool-slide automatically moves down to broach parts and stops, work is unclamped as shuttle table moves out to unloading position, tools rise to starting position and stop. Cutting speed 30 ft. per min. Return speed 80 ft. per min. Thus, sequent oper-



PRODUCTION: 175 per hr.

TOOLS: Sectional type. Individual sections for the various surfaces broached on each operation are fitted in a holder and mounted on the tool-slide as a complete unit. Tool holders are staggered to reduce broaching force.

FIXTURE: Automatic dual-jaw type with spring-loaded wedges for automatically clamping and unclamping parts as shuttle table moves into the broaching position and out to the loading position.

MACHINE: Single-slide surface broaching machine, 12x30-in. stroke.

CYCLE: Operator locates the broached oval hole in parts over pins and depresses dual safety control buttons. Shuttle table moves into broaching position and jaws clamp parts in place. (An automatically operated wedge rigidly backs up the protruding end of the left-hand part

for clamping and unclamping the part as the shuttle table moves to and from the broaching position.

MACHINE: Single-slide vertical surface broaching machine, 42-in stroke.

CYCLE: Operator places the rough part over a locating pin and depresses the dual safety control buttons. The shuttle table moves to the broaching position and the jaw automatically clamps the part in place. The tool-slide automatically moves down to broach the part and stops momentarily as the shuttle table moves out to the unloading position, automatically unclamping the part. The tool-slide rises to starting position and stops. The cycle is semi-automatic. Cutting speed, 30 ft. per min. Return speed, 80 ft. per min.

RIFLE TRIGGER

MATERIAL: Forged carbon steel.

FIRST OPERATION: Finish broach both sides of trigger from rough forging with the left-hand set of tools and fixture.

STOCK REMOVED: 0.025 in. maximum per side.

SECOND OPERATION: After the small hole has been drilled the contour, consisting of $\frac{5}{8}$ in., $\frac{7}{8}$ in., $\frac{3}{16}$ in. and $\frac{1}{4}$ in. radii and a short straight surface, is finished broached with the center tools and fixture.

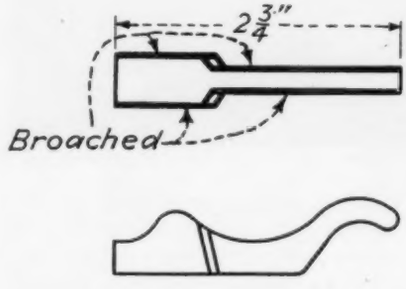
STOCK REMOVED: 0.040 in. maximum entire surface.

THIRD OPERATION: Finish broach a $\frac{1}{2}$ in. wide by $1\frac{3}{4}$ in. long surface with the right-hand tool and fixture.

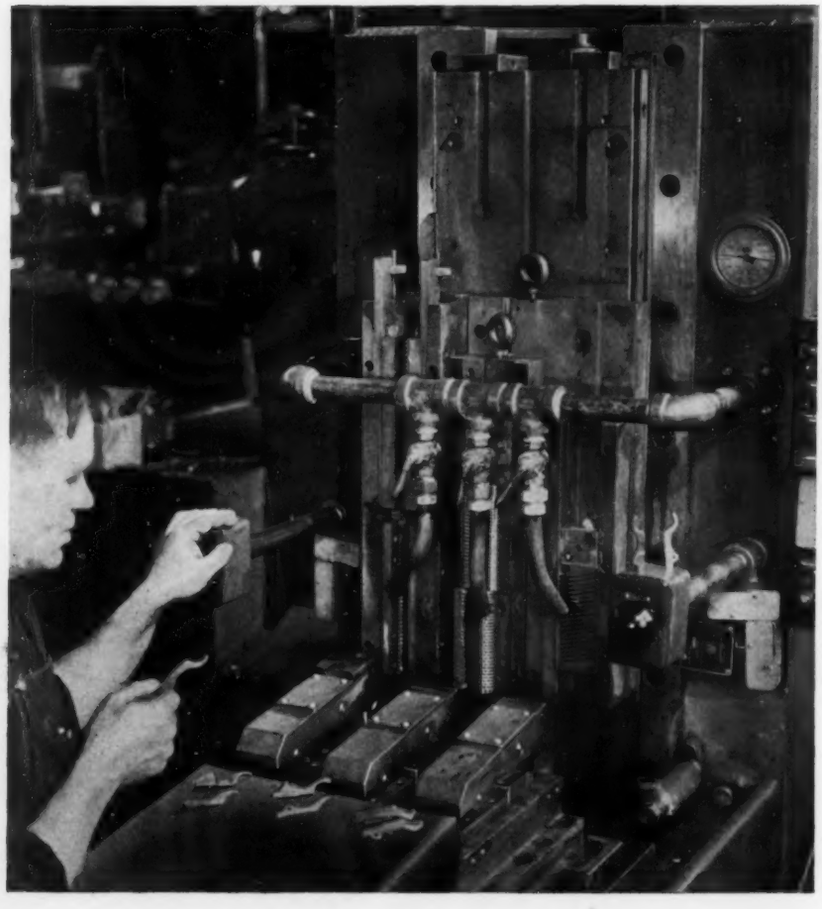
STOCK REMOVED: 0.040 in. maximum.

PRODUCTION: 175 finished pieces per hr.

TOOLS: First operation — Shear type with the lower opposing tools broaching the narrow and angular surfaces and upper opposing tools broaching the wide surfaces. Second operation—Special form type with the lower sections broaching surfaces marked *A* and *B* and the upper sections broaching surfaces marked *C* and *D*.



FIRST OPERATION

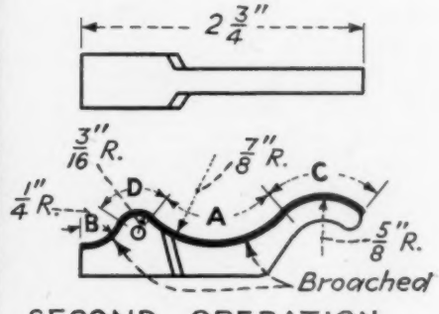


THIRD OPERATION—ONE-PIECE SHEAR TYPE

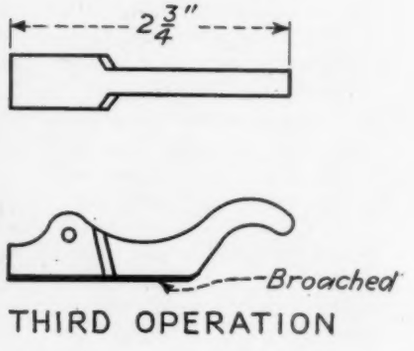
FIXTURE: Triple automatic jaw type with spring-loaded wedges for automatically clamping and unclamping three parts in unison as the shuttle table moves to and from the broaching position.

MACHINE: Single-slide vertical surface broaching machine, 30-in. stroke.

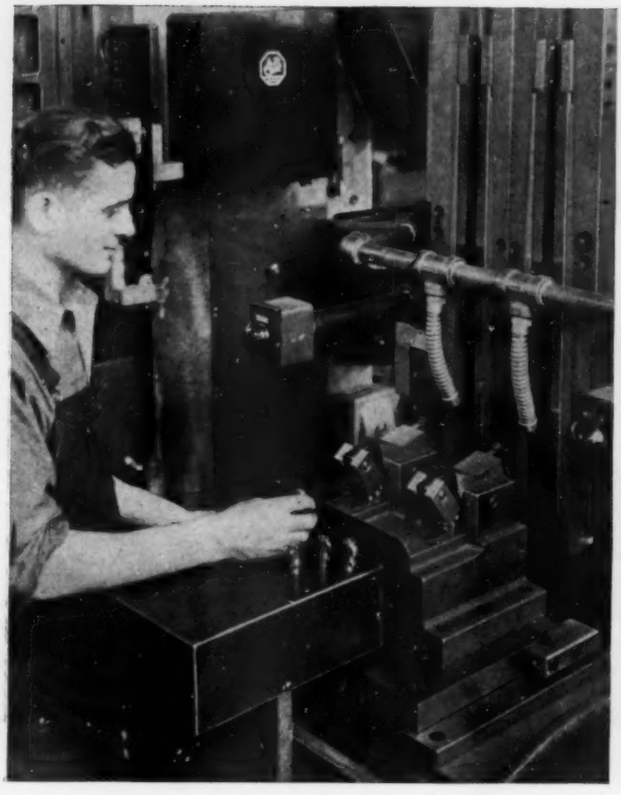
CYCLE: Operator loads three parts in the sequence in which they are to be broached and depresses the dual safety control buttons. Shuttle table moves into broaching position as the jaws automatically clamp the parts in place. The tool-slide automatically moves down to broach the parts and stops momentarily as the shuttle table moves out to unloading position automatically unclamping the parts. The tool-slide rises to starting position and stops. The cycle is semi-automatic. The part broached in the left-hand fixture is placed in the center fixture and the part broached in the center fixture is placed in the left-hand fixture. One part is completely finished with each cycle of the machine. Cutting speed, 30 ft. per min. Return speed, 80 ft. per min.

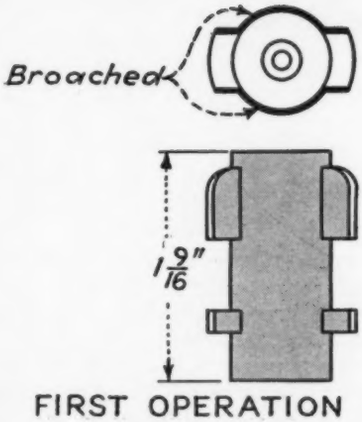


SECOND OPERATION



THIRD OPERATION





FIRST OPERATION

FRONT LOCKING LUG

FIRST OPERATION

MATERIAL: Forged carbon steel.

OPERATION: Finish broach two arc surfaces and four straight surfaces on two parts per stroke.

STOCK REMOVED: 0.150 in. on each arc and straight surface.

PRODUCTION: 500 pieces per hr.

TOOLS: Special slab type formed to suit the surfaces broached.

FIXTURE: Automatic spring-loaded lever-type jaw clamps for automatically clamping the part as the shuttle table moves to the broaching position and automatic unclamping of parts as the shuttle table moves to the unloading position.

MACHINE: Single-slide vertical surface broaching machine, 30-in. stroke.

CYCLE: Operator places a rough part in each fixture and depresses the dual safety control buttons. Shuttle table moves into the broaching position and the jaws automatically clamp the parts in place. The tool-slide automatically moves down to broach the part and stops momentarily as the shuttle table moves out to the loading position where the parts are automatically unclamped. The tool-slide rises to starting position and stops as the operator removes the finished parts and installs two rough parts. The cycle is semi-automatic. Cutting speed, 30 ft. per min. Return speed, 80 ft. per min.

SECOND OPERATION

MATERIAL: Forged carbon steel.

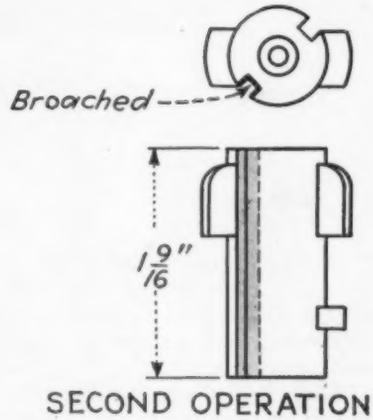
OPERATION: Finish broach a 0.115 in. wide by 0.120 in. deep extractor keyway in four parts per stroke.

STOCK REMOVED: 0.120 in.

PRODUCTION: 860 pieces per hr.

TOOLS: Standard saw or cutter bar type.

FIXTURE: Automatic spring-loaded wedge and jaw type for automatically clamping the part in position as the shuttle table moves to the broaching position and unclamps the parts as the shuttle table moves to the loading position.



SECOND OPERATION

MACHINE: Single-slide vertical broaching machine, 6x30-in. stroke.

CYCLE: Operator places four parts previously broached over locating pins and depresses the dual safety control buttons. The shuttle table moves into the broaching position and the four jaws automatically clamp the parts in place. The tool-slide automatically moves down to broach parts and stops momentarily as the shuttle table moves out to loading position where the parts are automatically unclamped. The tool-slide rises to starting position and stops. The cycle is semi-automatic. Cutting speed, 30 ft. per min. Return, 80 ft. per min.

Can Men Be Measured?

Rating an employee is just as important as rating his job. Here's a plan to take the guesswork out of wage payment. It can be used in any plant

By A. L. KRESS
Director of Industrial Relations
National Metal Trades Association

SIT DOWN, JIM. What's on your mind this morning?" Mr. Tate, the factory manager was addressing the foreman of the assembly department.

"Well, Mr. Tate, it's like this. At the last foremen's meeting, you explained the new plan we are going to use to rate our men. I have been foreman of my department for fifteen years and it seems to me, I certainly ought to know my men so well that I don't need a rating plant to tell me how good they are."

"I'm glad you came in, Jim. If we haven't put up our employee rating plan to our foreman so clearly that you all see how it will help you, then we haven't done our part of the job. Suppose you tell me just what you have in mind."

"Well, Mr. Tate, we don't see how it can help us. Why do we need anything like that?"

"I wonder, Jim, if you ever stopped to think about top management's problem in trying to be sure that jobs and men are being paid fairly? Obviously, we have to rely on the judgment of our department foremen as to the worth of their men. The trouble is that you all have different yardsticks and every once in a while a situation comes up where we simply can't justify some employee's rate. Then too, you fellows suddenly decide some man isn't any good after he has been with you five or six years and you say he never was any good. Why should it take so long to find that out?

"Let me read from the Metal Trades' Manual on Employee Rating:

" 'Management is constantly faced with the problem of how to appraise the performance of employees fairly. How does one employee compare with another in terms of performance and value to the organization? How much more, or less, is one person worth than others doing the same work? Who are promotion prospects because of their interest, knowledge of their jobs and outside efforts to improve themselves and qualify for advancement? If a man asks for an increase, is he worth it, compared with other men on the same job? These questions come up all the time, and management—the supervisory force is definitely a part of management—is continually trying to answer them fairly.

" 'Such questions can be answered on the basis of general impressions, opinions, or hunches, or by trying to appraise individuals in terms of definite performance factors. The persons who are affected by these decisions are, of course, deeply concerned. Obviously, here is one of the most concrete places to promote sound industrial relations.'

"Now there is the problem which faces us. We want the considered judgment of our foremen as to the ability of their men, in terms of concrete performance factors. We want each foreman to measure his men with the same yardstick, so that we have some consistency in judgment. Most of all, we want some facts to go on. Quite frankly, in this task of appraising individuals and their value to

the company, we don't know of any other or better way than to set up some standards of performance that our foremen can use to check their own judgment against."

"I guess I never looked at the problem that way, Mr. Tate. But when you put it up to me, as you have, I can begin to see why the company is going into employee rating. I have been around here twenty years and the thing which impresses me the most is the fact that top management always seems to have some good reasons why it adopts certain policies."

"Now, don't get me wrong, Jim," continued Mr. Tate, "This employee rating isn't going to fix up all our problems. It is more apt to show us what some of our problems are. And it isn't going to mean you fellows won't have to use your heads in sizing up men. But here is the sort of thing I don't like. We just finished rating all our jobs and we found half a dozen men who can only qualify as Class D toolmakers getting Class A rates. I am just as much to blame as anybody else for the situation, but I still don't like it. I think if we use this employee rating plan right it will help us avoid such situations."

"You don't have to say anything more to sell me on the idea, Mr .Tate. But if I am not taking up too much of your time, it would help me if you could point out just how I, as a foreman, can help put this plan across so we all get the most out of it."

"Well, in the first place, Jim, there are just six simple, basic things we are going to rate employees on—quality of work, quantity of work, adaptability, job knowledge, dependability, attitude. In order to make it easy to rate your men and to give every foreman the same yardstick for rating, four specifications have been developed for each of these factors. Let's take Dependability. The top rating on this says: 'When you give him a job to do, have you the utmost confidence that you will get what you want when you want it?' The others are similarly specified or described. Now, all you have to do is appraise each man just as fairly and honestly as you can. Don't try to prove anything. Let the answers come out as they will. Let's go at this with the idea of finding out how good a job we have done in the past, rather than trying to prove we *have* done a good job. We will undoubtedly find cases of inequalities, cases where men should never have been hired, or never retained after they were hired. Those cases will have to be handled with tact and sympathy. But we aren't out to show anybody up or put someone on the carpet for what has been done."

"I have to other questions, Mr. Tate, and then I'll go. Do you want to talk over our department ratings with us and what should we say if the men find out about it?"

"Let me answer your last question first, Jim. Of course, the men will find out about it. There isn't any reason why they shouldn't know exactly what we are doing. We think this is just as much to their advantage as to ours.

"I am going to make it a point to go over all department ratings with every foreman, the superintendent and industrial relations manager. I want a general agreement on every man's rating. That doesn't mean we are going to vote on them, or compromise. When there are differences of opinion, let's discuss them and reach a unanimous decision. Quite frankly, where a department foreman shows he understands the plan and is doing as straightforward a job as he knows how in his ratings, I am going to take his judgment.

TABLE I—Point Values for Rating Employees

Factor	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8
1. Quality of Work	25	23	20	18	15	13	10	8
2. Quantity of Work	20	18	16	14	12	10	8	6
3. Adaptability	15	13	12	10	9	7	6	4
4. Job Knowledge	20	18	16	14	12	10	8	6
5. Dependability	10	9	8	7	6	5	4	3
6. Attitude	10	9	8	7	6	5	4	3
Totals	100	90	80	70	60	50	40	30

EMPLOYEE RATING REPORT

NAME_____ NO._____ TOTAL POINTS_____ GROUP_____

DEPT._____ OCCUPATION_____ CLASS_____

RATED BY_____ DATE_____ APPROVED BY_____ DATE_____

INSTRUCTIONS—Read Carefully

Each employe's ability and fitness in his PRESENT occupation or for promotion may be appraised with a reasonable degree of accuracy and uniformity, through this rating report. The rating requires the appraisal of an employe in terms of his ACTUAL PERFORMANCE. It is essential, therefore, that snap judgment be replaced by careful analysis. Please follow these instructions carefully:

1. Use your own independent judgment.
2. Disregard your general impression of the employe and concentrate on one factor at a time.
3. Study carefully the definitions given for each factor and the specifications for each degree.
4. When rating an employe, call to mind instances that are typical of his work and way of acting. Do not be influenced by UNUSUAL CASES which are not typical.
5. Make your rating with the utmost care and thought; be sure that it represents a fair and square opinion. DO NOT ALLOW PERSONAL FEELINGS TO GOVERN YOUR RATING.
6. After you have rated the employe on all six factors, write under the heading "General Comments" on the back, any additional information about the employe which you feel has not been covered by the rating report, but which is essential to a fair appraisal.
7. Read all four specifications for Factor No. 1. After you have determined which specification most nearly fits the employe, place an X in the small square over it. If the specification adequately fits the employe, place an X in the left square. If he does not quite measure up to the specification but is definitely better than the specification for the next lower degree, place an X in the right square. Repeat for each factor.

FACTOR	R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8
What Has He Done?								
1 QUALITY OF WORK — THIS FACTOR APPRAISES THE EMPLOYE'S PERFORMANCE IN MEETING ESTABLISHED QUALITY STANDARDS.	☐ DOES HE CONSISTENTLY DO AN EXCELLENT JOB? ARE REJECTS AND ERRORS VERY RARE?	☐	☐ DOES HE USUALLY DO A GOOD JOB? DOES HE SELDOM MAKE ERRORS?	☐	☐ IS HIS WORK USUALLY PASSABLE? MUST YOU SOMETIMES TELL HIM TO DO A BETTER JOB?	☐	☐ IS HE CARELESS? DOES HIS WORK ONLY GET BY? DOES HE OFTEN MAKE MISTAKES?	☐
2 QUANTITY OF WORK — THIS FACTOR APPRAISES THE EMPLOYE'S OUTPUT OF SATISFACTORY WORK.	☐ IS HIS OUTPUT UNUSUALLY HIGH? IS HE EXCEPTIONALLY FAST?	☐	☐ DOES HE USUALLY DO MORE THAN IS EXPECTED? IS HE FAST?	☐	☐ DOES HE TURN OUT THE REQUIRED AMOUNT OF WORK BUT SELDOM MORE?	☐	☐ IS HE SLOW? IS HIS OUTPUT FREQUENTLY BELOW THE REQUIRED AMOUNT?	☐
What Can He Do?								
3 ADAPTABILITY — THIS FACTOR APPRAISES THE EMPLOYE'S ABILITY TO MEET CHANGED CONDITIONS AND THE EASE WITH WHICH HE LEARNS NEW DUTIES.	☐ DOES HE LEARN NEW DUTIES AND MEET CHANGED CONDITIONS VERY QUICKLY AND EASILY?	☐	☐ CAN HE TURN FROM ONE TYPE OF WORK TO ANOTHER OR GRASP NEW IDEAS IF GIVEN A LITTLE TIME AND INSTRUCTION? DOES HE ADJUST HIMSELF TO NEW CONDITIONS WITH LITTLE DIFFICULTY?	☐	☐ IS HE A ROUTINE WORKER? DOES HE REQUIRE DETAILED INSTRUCTION ON NEW DUTIES AND METHODS?	☐	☐ IS HE SLOW TO LEARN, REQUIRING REPEATED INSTRUCTIONS? DOES HE HAVE GREAT DIFFICULTY IN ADJUSTING HIMSELF TO NEW WORK?	☐
4 JOB KNOWLEDGE — THIS FACTOR APPRAISES HOW WELL THE EMPLOYE KNOWS HIS JOB.	☐ IS HE AN EXPERT ON H'S JOB? DOES HE MAKE THE MOST OF HIS KNOWLEDGE AND EXPERIENCE? IS HE A SELF-STARTER?	☐	☐ IS HE WELL INFORMED ON HIS JOB AND RELATED WORK, RARELY NEEDING ASSISTANCE AND INSTRUCTION BUT ASKING FOR THEM WHEN IT WILL SAVE TIME?	☐	☐ DOES HE KNOW HIS JOB FAIRLY WELL? DOES HE REGULARLY REQUIRE SUPERVISION AND INSTRUCTION?	☐	☐ IS HIS KNOWLEDGE OF HIS JOB LIMITED? DOES HE SHOW LITTLE DESIRE OR ABILITY TO IMPROVE HIMSELF?	☐
Can You Rely on Him?								
5 DEPENDABILITY — THIS FACTOR APPRAISES YOUR CONFIDENCE IN THE EMPLOYE TO CARRY OUT ALL INSTRUCTIONS CONSCIENTIOUSLY.	☐ WHEN YOU GIVE HIM A JOB TO DO, HAVE YOU THE UTMOST CONFIDENCE THAT YOU WILL GET WHAT YOU WANT WHEN YOU WANT IT?	☐	☐ DOES HE FOLLOW INSTRUCTIONS AND DO WHAT YOU EXPECT HIM TO DO WITH LITTLE FOLLOW UP?	☐	☐ DOES HE GENERALLY FOLLOW INSTRUCTIONS BUT OCCASIONALLY NEED FOLLOWING UP?	☐	☐ DOES HE REQUIRE FREQUENT FOLLOW UP, EVEN ON ROUTINE DUTIES?	☐
6 ATTITUDE — THIS FACTOR APPRAISES THE EMPLOYE'S OPENMINDEDNESS, AND HIS WILLINGNESS TO COOPERATE IN CARRYING OUT SAFETY AND OTHER COMPANY POLICIES.	☐ IS HE AN EXCEPTIONALLY GOOD TEAM WORKER? DOES HE INVARIABLY GO OUT OF HIS WAY TO COOPERATE? IS HE ALWAYS READY TO TRY OUT NEW IDEAS?	☐	☐ DOES HE MEET OTHERS HALF WAY AND GO OUT OF H'S WAY TO COOPERATE? IS HE USUALLY READY TO TRY OUT NEW IDEAS?	☐	☐ DOES HE USUALLY COOPERATE, BUT WITH SOME RELUCTANCE TO ACCEPT SUGGESTIONS AND TRY OUT NEW IDEAS?	☐	☐ DOES HE COOPERATE ONLY WHEN HE HAS TO? IS HE UNWILLING TO TRY OUT NEW IDEAS? DOES HE HAVE LITTLE INTEREST IN HIS JOB?	☐

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"Now as to the men themselves, we think the primary purpose of employee rating is to raise the standard of performance through enlisting the interest of the individual employee in improving his own performance and hence his rating. We want to use the individual ratings in a friendly way to point out individual shortcomings. That is going to take a lot of tact and judgment. Probably we shall make some mistakes in trying to do this but we won't hesitate to remedy them. Of course, it goes without saying, that each individual's rating should be considered as confidential and not discussed with others. That is the only way we can build up confidence in our sincerity of purpose."

"Thanks a lot, Mr. Tate. Why don't you tell the boys at our next foreman's meeting what you have told me?"

"Sure, I'll do that, Jim. Thanks for the suggestion."

The above conversation might well take place in any plant in which employee rating is being introduced. It illustrates the attitude in which management should approach the problem. The Metal Trades employee rating plan, in conjunction with its job rating plan, is a concrete contribution to the better appraisal and reward of individual performance.

In a previous article (*AM*—Vol. 83, page 667), the way to answer the question, "How does Bill Smith's job compare with other jobs in the plant?", through the use of a job rating plan, was described in detail. The way to answer the question "How does Bill Smith himself compare with other men on the job?" is to use an employee rating plan.

Invariably, when jobs have been rated and employees classified according to occupation or type of work performed, marked differences in rates of pay between men doing the same job, will be found. Obviously management wants to know if such differences are warranted.

An employee rating plan, properly applied, can therefore:

1. Assist management in eliminating unwarranted inequalities in rates of pay.

2. Provide a factual basis for wage adjustments or for decisions as to transfers, promotion or layoffs.

3. Furnish a basis for appraising the new employee to determine the progress he is making and whether he should be retained.

4. Stimulate interest in self-improvement where the ratings are used in a friendly, constructive way to point out shortcomings.

Table II—Employee Rating Group and Pay

Group	Point range	Per cent of wage band added to base pay	Rate of pay (cents per hr.)
1	91 to 100	100	90.0
2	81 to 90	75	87.5
3	71 to 80	50	85.0
4	61 to 70	25	82.5
5	60 or less	0	80.0

The Metal Trades employee rating form is shown in Fig. 1. It carries with it the specifications the foreman is to use in appraising Bill Smith, in the form of four sets of questions for each factor. Thus, the foreman is given a definite yardstick against which to check his own judgment. This is particularly important because an employee rating plan, to be successful, must set up some definite standards of performance for each factor rated, so that the foreman can say, for example, "that fits Bill Smith, he's always ready to go out of his way to cooperate or try new ideas."

The point values or weights given the six factors are shown in Table 1. Thus, Quality of Work is given 25 per cent, Quantity of Work 20 per cent, Adaptability 15 per cent, Job Knowledge 20 per cent, Dependability 10 per cent and Attitude 10 per cent. The total maximum score is 100 points. There can be differences of opinion as to the relative weights to be given these factors. It's immaterial what weights they are given so long as men are consistently rated, since the purpose primarily is to develop a comparative picture of men doing the same job. Where there is only one man on a job, the rating shows how nearly his own performance comes up to standard.

In the application of an employee rating plan in a plant, a good way *not* to introduce it is to supply each foreman with a lot of rating sheets and tell him to send them in within two weeks. The entire program should be explained and discussed at a foreman's meeting. Some one person, preferably the industrial relations manager, if there is one, should be made responsible for the program. This person should work with each foreman, helping him to think through a fair rating for each man.

If a company applies the Metal Trades plan and comes out with a plant average of 88 points, the chances are the ratings have not been carefully made. The same thing applies if the plant average were 52. In the first case, it is quite likely men were over-rated, and in the second instance, under-rated.

Where the rating plan has been properly applied, the following distribution will usually be found:

Group 1..... 2–5 per cent
Group 2..... 7–15 per cent
Group 3.....60–75 per cent
Group 4..... 8–16 per cent
Group 5..... 2–5 per cent

These percentages are, of course, approximate only. Under normal conditions, about two-thirds of the working force will fall in Group 3.

Now let us see how this plan helps management to answer the question, "How does Bill Smith compare with other men on that job?" Suppose that rate ranges have been fixed for each job, based on the job rating. There are nine other men in the same job classification with Bill Smith and all ten have been rated. Bill himself comes out with 82 points, which puts him in Group 2. Let us assume the range from the minimum to the maximum is $.10 per hour, for the particular job, which is on day work. Referring to Table II, then Bill Smith would be entitled to the minimum rate plus three-fourths of the $0.10 range or $.075.

It should be pointed out that where jobs are rated, the job with the highest total points should carry the highest rate range. If two hundred men are rated, however, it does not follow that the ten men who may fall in Group 1 should necessarily be the ten highest paid men in the plant or all receive the same rate. The results of the employee rating plan must always be interpreted in connection with the specific jobs on which the men are employed. The ratings may show a Group 1 man on Class C welding and another Group 1 man on Class A welding. This simply means that each man is the best within his own job classification.

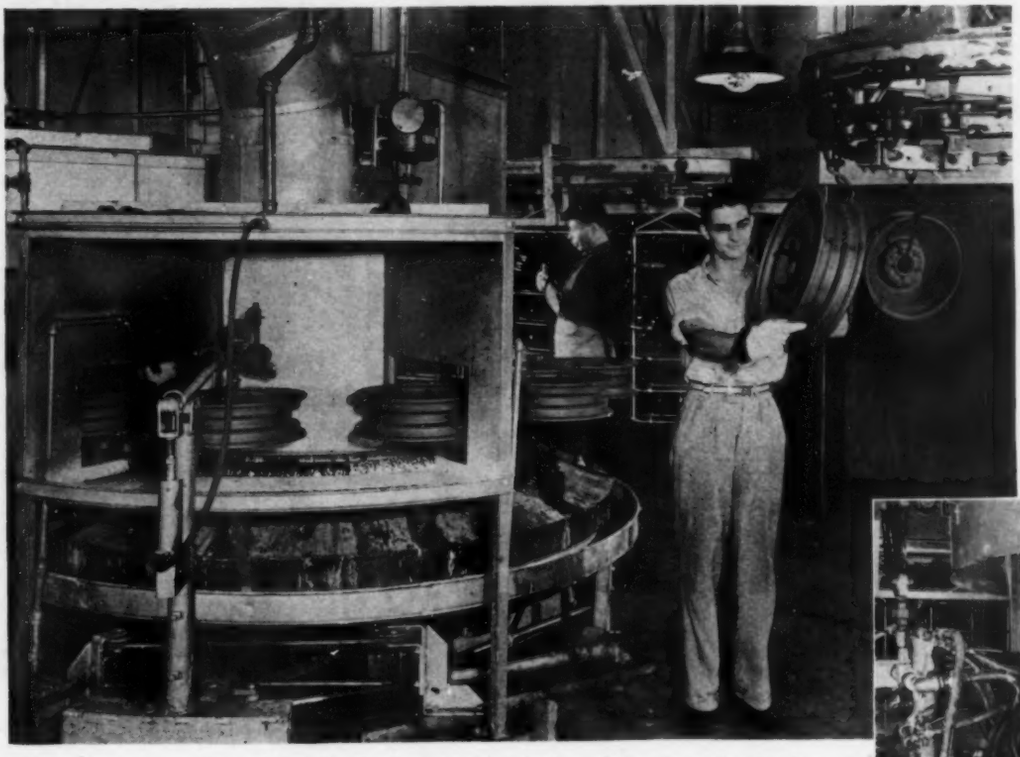
In conclusion, the following points should constantly be kept in mind in applying any employee rating plan:

1. An employee rating plan may be applied to advantage even though jobs have not been rated. It will be even more helpful, however, where it is used after jobs have been rated. In the first instance some kind of a job classification should be set up.

2. Foremen are the key men in the actual rating. They must understand the plan and be sold on its value.

3. The value of employee rating depends on the soundness of the plan and upon the fairness with which ratings are made. Personal likes and dislikes have no place in rating men.

Merry-Go-Round at Work



An oscillating spray-head carriage moves with the turntable and first sprays the back and rim at one station and the outside face of the wheel at the next. Sprays are cut off automatically when the wheel passes beyond reach

Floor space is conserved in the Dodge wheel-painting department by having the incoming and outgoing conveyors pass adjacent to the loading and unloading stations of an automatic turntable-type spraying machine

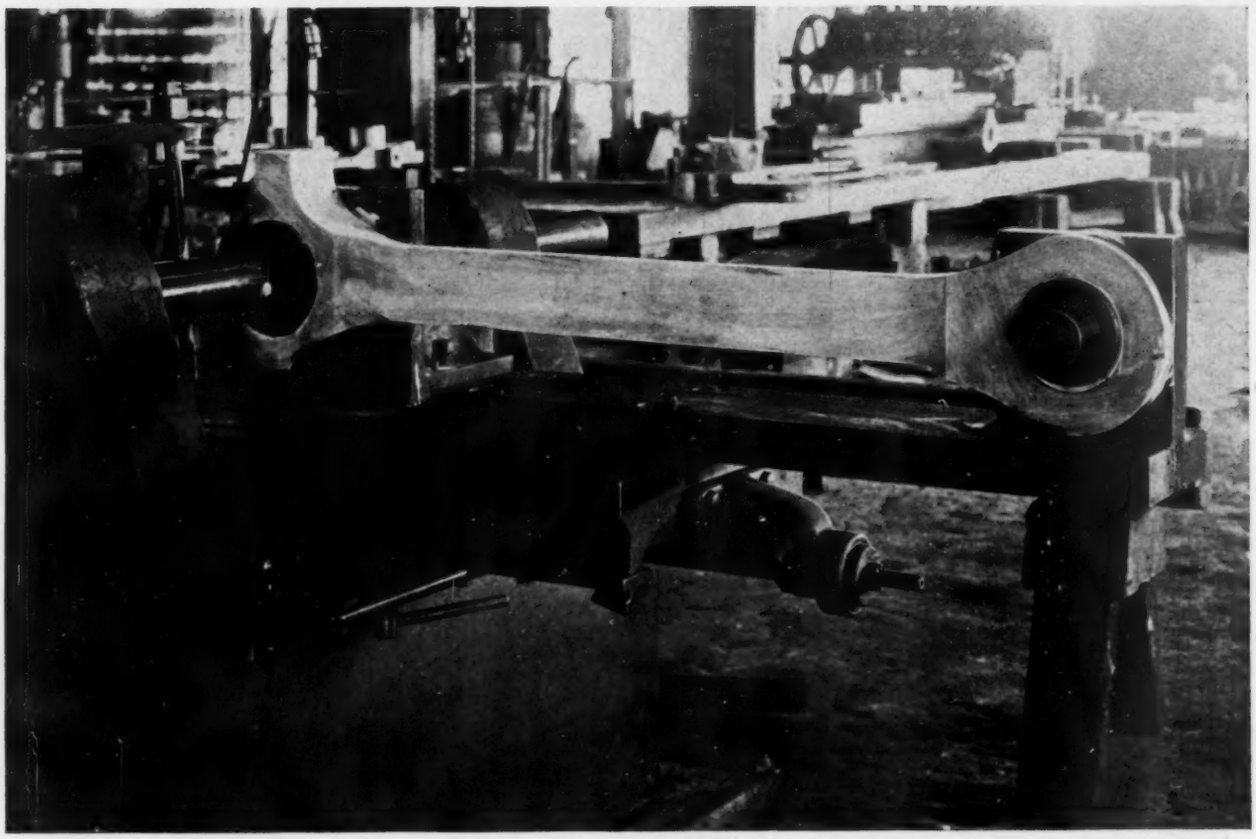
A turntable in the paint shop saves time, space and labor for Dodge. Result: better wheels at less cost

DODGE DIVISION of Chrysler Corporation is automatically spraying wheels in a setup which saves considerable floor space over the previous method. Heart of the scheme is a new turntable machine that wire-brushes, air blasts and sprays the entire wheel.

One operator removes wheels from an incoming-material conveyor and places them on the rotating vertical spindles of the automatic spraying machine. Another man at the delivery station transfers the painted wheels to special conveyor racks that carry the wheels into a new indirect-fired baking oven maintained at 240 deg. F. Wheels are baked for 60 min. and then move to a cooling loop below the oven. Here air from the working floor is passed over them by exhaust fans. As the wheels leave the cooling room, they pass by striping stands, where they are removed for this operation and then returned to the conveyor for an air dry before being taken to storage.

The automatic spraying machine has eleven rotating spindles. As the wheel is wire brushed, the dirt and rust are sucked up by a built-in exhaust hood which also catches dirt loosened by the adjacent air blast. Another integral exhaust system with a water wash removes paint fumes at the spraying stations. The wash water is sent to a shallow open sump alongside the machine. Paint solids are periodically skimmed off the surface of the water and used again in compounding the neutral color used on the rim and the back of the wheel. This color is applied to the rim by two guns and to the back by another pair of guns. Three more guns spray trim color on the outside face, this operation being done at the next station so that the trim color will properly overlap the neutral shade. All spray guns are mounted on an oscillating carriage which follows the wheels passing by on the turntable. The sprays are cut on and off automatically by cam action as the wheel passes through the spray zone.

Ten standard colors are sprayed in production. When the trim color is to be changed, the guns are removed from quick-change fixtures and others substituted. Hoses are connected to a manifold fed with the ten desired colors by a central mixing room. The synthetic enamel used is a high-viscosity type that leaves a thicker dried film in one coat than was obtained with two manually sprayed coats.



Crankpin holes of front, number two, and rear side rods are bored in this fixture. Forked end of the rod is positioned by a pin in an extension bolted to the boring machine table

Precision for the Long Haul

No longer is "any old fit" good enough for locomotive parts. Machining solid-end side rods, for instance, has turned out to be a precision job. Special fixtures make it easy

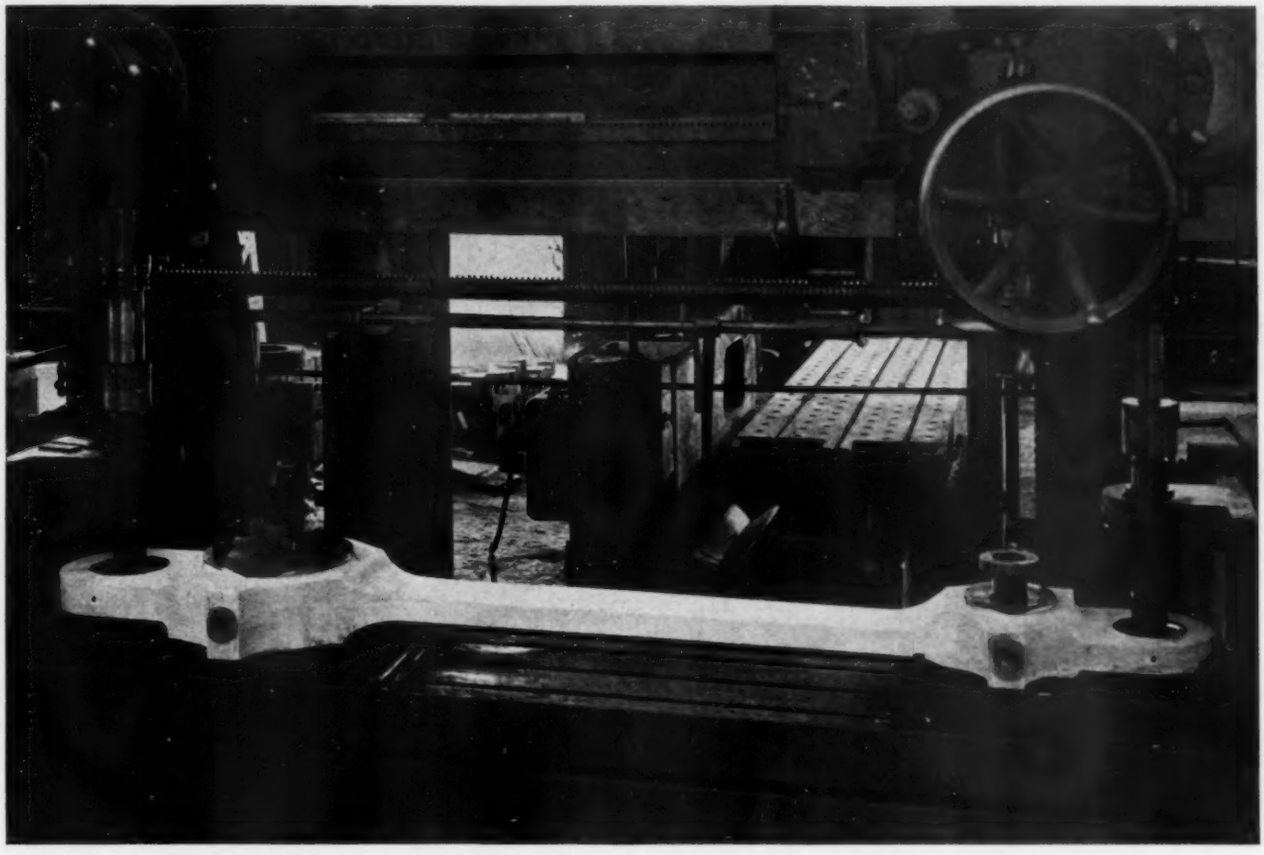
By FRED H. COLVIN
Editor Emeritus, American Machinist

As LOCOMOTIVE SPEEDS have jumped and pressures climbed, solid-end main and side rods have been adopted to withstand the more severe service. These rods must be precision machined to secure the center distances required. To achieve the necessary accuracy Lima Locomotive Works has devised special boring and inspection jigs. Those for an eight-coupled engine are described here.

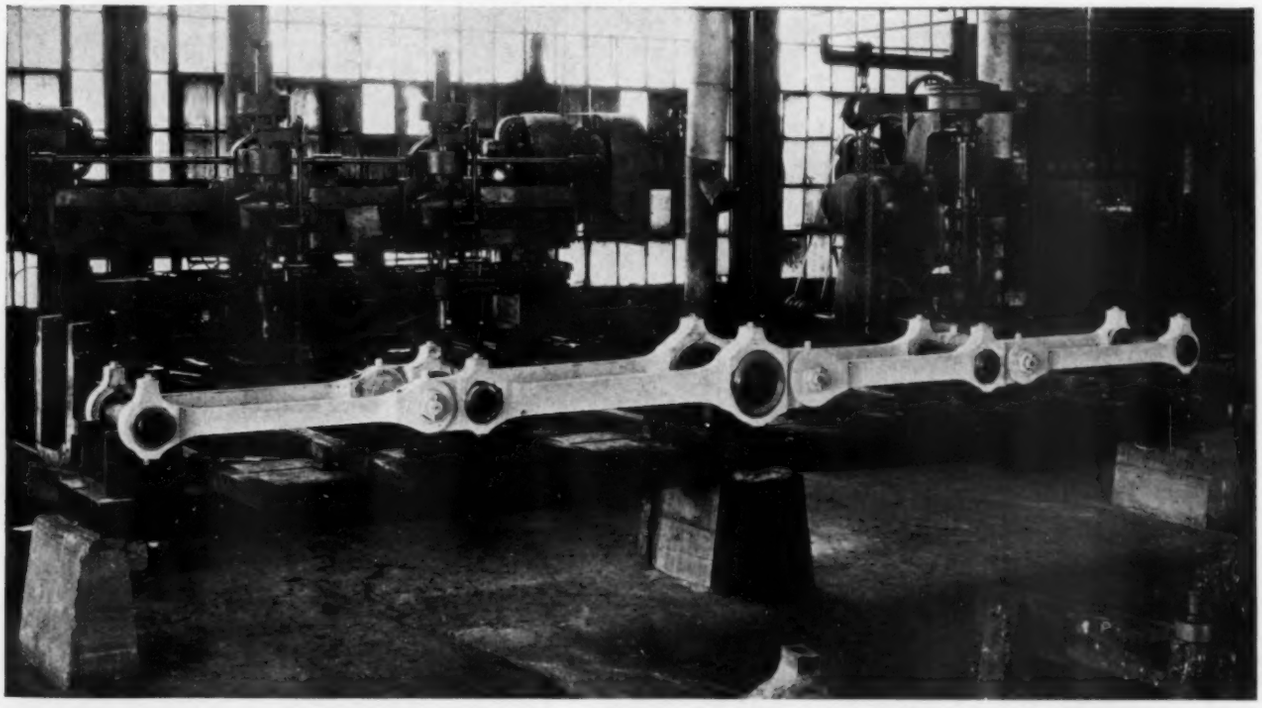
Front, number two, and rear side rods are bored on a horizontal machine. The forked end of each rod is positioned by a pin in an extension bolted to the boring machine table. The end to be bored is supported by angle plate on the table, square with this pin. Center distance is checked by a toolmaker before boring is begun. The large-diameter boring bar is supported by substantial bearings and is driven from the machine spindle.

Main side rods have their knuckle-pin holes finished on a boring machine with double vertical heads. Each rod is both supported and located by cone plugs in the two crankpin holes. These plugs are part of special angle jig plates which carry hardened sleeves to guide the boring bars fitted with single-point cutters.

After they are bored and the bushings applied, the rods for both sides of a locomotive are assembled on an inspection fixture in the rod department. This fixture consists of a heavy cast-iron bed mounted on three concrete columns. Its surface is slotted so that heads carrying the plugs, or dummy crankpins, can be adjusted to duplicate locomotive dimensions. Removable wooden crossbars hold rods before they are placed on the dummy pins. If the rods can then be assembled on the fixture, there is no question that they will go into place on the locomotive. In the case illustrated, this means accuracy at eight points—at five crankpins and three knuckle joints.



For boring knuckle-pin holes in main side rods, each rod is both supported and located by cone plugs in the two crankpin holes. These plugs are part of special angle jig plates which carry hardened sleeves to guide the boring bars



This inspection fixture carries dummy crankpins which are adjusted to duplicate locomotive dimensions. If finished rods can then be assembled on it, they can be mounted on the locomotive without any trouble

IDEAS FROM PRACTICAL MEN

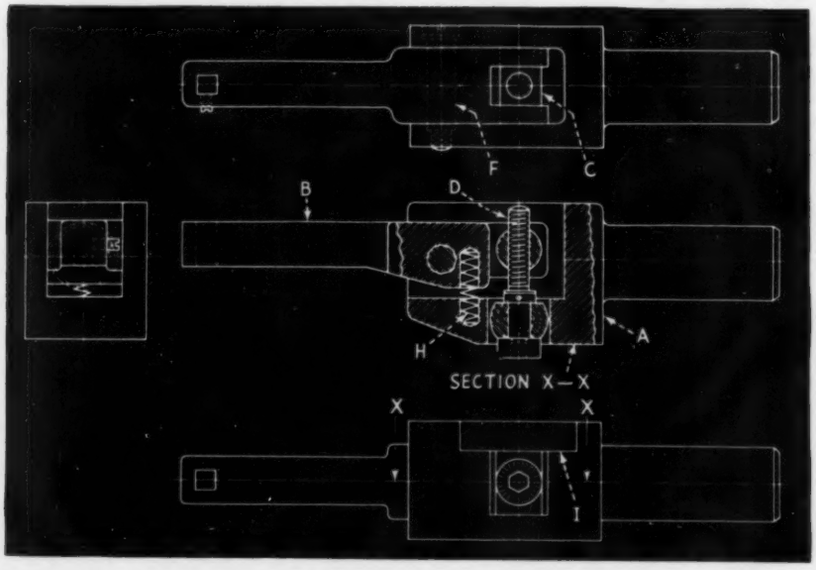
Pivot-Type Adjustable Boring Head

By JOHN A. HONEGGER

The pivot-type boring head illustrated can be used in a turret lathe, milling machine or drill press. Essentially it consists of the housing *A* which is an integral part of the shank and is machined as shown to accommodate the various component parts; the boring bar *B* in the outer part of which the toolbit is held; the bar pivot *C* which is drilled and tapped to receive the adjusting screw *D;* the pivot stud *F* on which the boring bar swings; the spring *H* to take up lost motion; the cover plate *I;* and the necessary screws.

The boring bar is a snug fit in the housing and is forked at its inner end to accommodate the bar pivot. The adjusting screw has 20 threads per in. and its socket head is graduated into 25 divisions. After the various parts have been assembled, the cover plate is put on to keep out the chips and dirt.

In operation, turning the adjusting screw clockwise causes the outer end of the boring bar containing the toolbit to move outward from the center, compressing the spring. Turning the screw in the opposite direction causes the outer end of the bar to move inward toward the center, the spring taking up any lost motion in the adjusting mechanism.

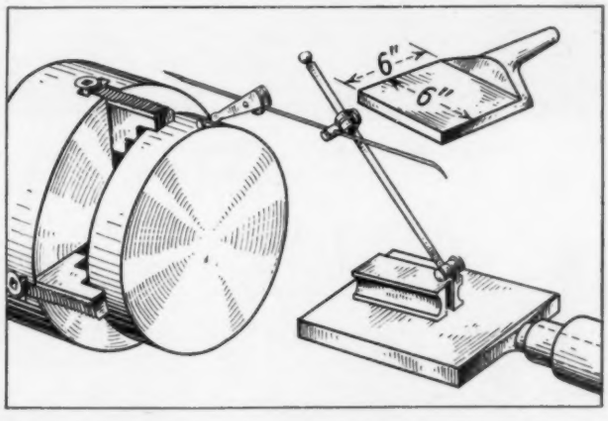


Boring heads used in turret lathes, milling machines or drill presses are quite a convenience for boring shallow holes, especially if the holes are blind

A Tailstock Plate Aids Scribing and Indicating

By CHARLES HOMEWOOD

The scribing and indicating plate illustrated is a convenient device for use in the toolroom or the job shop.



For scribing or indicating work held in the chuck or on the faceplate, this plate held by a taper shank in the tailstock spindle of the lathe is a convenience

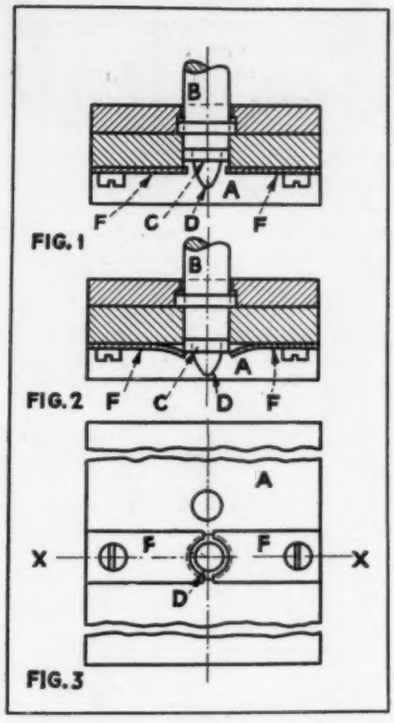
The plate itself is 6 in. square and has a shank to fit the taper hole in the tailstock spindle of the lathe. The surface of the plate is central with the shank and provides a broad base for the surface gage, the scriber of which can either be retained or replaced by a rod carrying an indicator. The device obviates the necessity of removing the tool and the toolpost to make room for the base of the surface gage on the upper surface of the toolblock when scribing or indicating work held in the chuck or mounted on the faceplate.

To get the best service from the plate, it should be made of mild steel, pack-hardened and ground. Face dimensions of 6 x 6 in. recommended.

One Way of Stripping Thin-Walled Work

By L. KASPER

It was required to punch a large quantity of washers in which the wall thickness was less than that of the stock. Since the washers were to be used as spacers, it was necessary that the center holes be accurately concentric with the outer diameter; therefore, the usual practice of locating the stock by a pilot on the end of the blanking punch was followed. However, due to the softness of the stock, the tendency in the blanking operation was for the washer to be crushed



Trouble in blanking washers was overcome by attaching two flat springs to the bottom of the die, the ends of which slightly overlapped the bottom of the die opening

against the pilot and to be lifted out of the die with the punch on the upstroke of the ram. The usual practice of changing the die clearance was tried without success, but the difficulty was finally overcome by a very simple arrangement of springs.

Referring to the illustration, Figs. 1 and 2 are partial sectional views on the line *X-X* in Fig. 3, which is a view of the under side of the die *A*. In Fig. 1 the blanking punch *B* has passed through the stock and forced the washer *C* into the die opening, the pilot *D* having entered the previously punched center hole. Two flat springs *F* are attached in a groove in the under side of the die, their ends slightly overlapping the die opening, as shown in Fig. 3. In Fig. 1 the ram has not reached the bottom of its stroke and up to this point the springs have been inactive. In Fig. 2 the ram is quite close to the bottom of its stroke and at this point the washer has contacted the springs where they overlap the die opening, bending them downward. Continued downward movement of the ram forces the outside of the washer between the ends of the springs, so that when the ram ascends it cannot follow the punch because its tendency to lift causes the springs to grip it more tightly and strip it from the pilot.

Universal Cut-off Die

By H. B. FAUGHT
Shop Contact Engineer, Lockwood Aircraft Corporation

In the illustration is shown a die that is used in a master die-set for producing blanks of rectangular shape, such as the one at *A*. One die of this type can be made to produce blanks of many different sizes to very close tolerances. The dimensions of the punch and the opening in the die and the amount the stop can be adjusted will, of course, govern the maximum size of blanks that can be cut in one die.

Referring to the illustration, the die member consists of the cold-rolled steel plate *B;* the die-block *C;* the spring-actuated stock guide *D;* the retaining block *F;* the adjustable stop *H;* the adjustable guide plate *I;* and the screw *K* for adjusting the stop. The adjustable guide plate is kept in alignment by the tongue *L* and after adjustment is locked in place by two capscrews. Two soft steel plugs *M* are pressed into holes in the die-block after it has been hardened. Dowel holes are transferred to plate *B* and to the soft steel plugs through the master die-shoe (not shown). Plate *B* and the die-block *C* are attached to the master die-set by two dowels and four filister-head screws.

The punch member consists of the cold-rolled steel punch plate *N* and the hardened tool steel punch *O* which is grooved at *P* to clear the stock stop and is provided with an ample heel at *S* to take the side thrust of the cut. The punch-plate has four clearance and two dowel holes through which it is attached to the master punch-holder by screws and dowels.

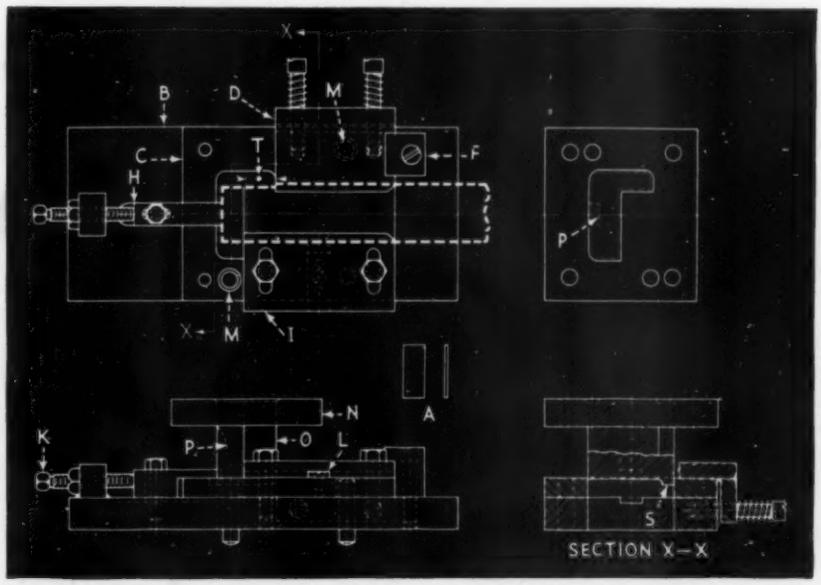
In operation, with the guide plate and the stock stop adjusted for the six blanks required, the stock is inserted between the guides and is advanced to, or nearly to, the die opening. When the ram descends, a portion of the stock is notched or cut away at *T*, leaving it the correct width for the blank. From then on it is merely a matter of keeping the stock fed against the stop to produce a blank of the correct dimensions at each succeeding stroke of the ram.

How to Determine the Strength of Taps

By HERBERT M. DARLING

Most manufacturers of taps test them carefully immediately after heat-treatment to discover any that may be soft, cracked, distorted or otherwise defective. About three times the force given should be applied in testing taps.

One testing device is shown in Fig. 1. Essentially it consists of a base casting and the two heads *A* and *B*. Head *A* carries a sliding spindle having a lever on its outer end and an enlarged portion which is bored to receive the tap driver *C*. Head *B* has a spindle bored in a similar manner for the tap holder *D* having a hole shaped to fit the flutes of the tap. The rear end of the spindle carries the arm *F* from which the weight



Rectangular blanks of various sizes and proportions can be cut in one die of this type by making use of the adjustments described

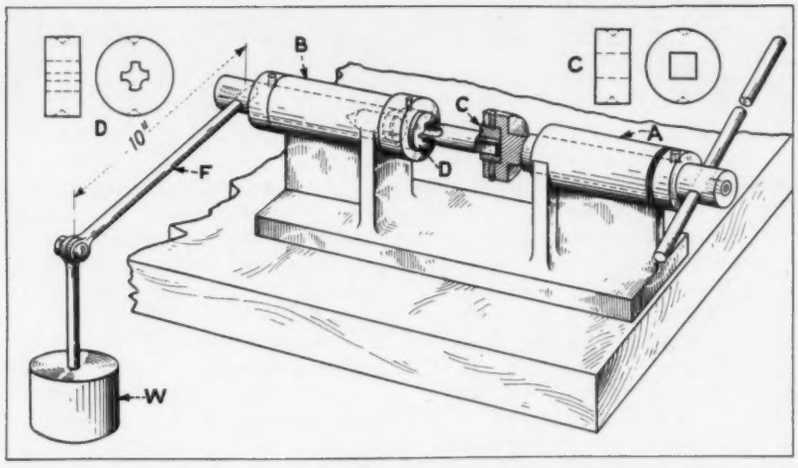


Fig. 1—The tap, rotated by one spindle causes the opposing spindle to rotate and lift a weight. If the tap has a flaw it will be broken by the strain

W is suspended, its center line being accurately 10 in. from that of the spindle.

In use, the operator puts the squared end of the tap in the square hole of the driver. Grasping the lever, he pushes the sliding spindle in head *A* forward until the fluted end of the tap enters holder *D* a distance about equal to its diameter. By pushing the lever downward the tap is rotated and causes the spindle in head *B* to revolve and to raise the weight *W*, putting a torsional strain on the tap. If the correct weight has been applied, a sound tap will cause it to be raised, but a cracked tap or one having an unseen flaw will be broken. The operator is furnished with a chart giving the weights to be applied for testing taps of different sizes.

The device illustrated in Fig. 2 has been made to test taps to destruction. It operates by compressing oil in a closed cylinder, the resulting pressure being converted into inch-pound torque readings by so calibrating the dial gage.

Essentially the device consists of a base on which the head *A* and the closed cylinder *B* are mounted, the spindle in the head being practically the same as that in the head *A* in Fig. 1. The spindle in the cylinder has a triple thread and travels through the stationary bronze nut *C* when revolved. The inner end of the spindle bears on the piston *D* in the cylinder which is filled with oil, a ball thrust bearing being placed between the two members to reduce friction.

In operation, with the tap held by the driver *F* and the holder *H*, rotating the spindle in the head causes the tap to rotate and the spindle in the cylinder to rotate and advance. The axial thrust of the threaded spindle against the piston compresses the oil in the cylinder, the pressure being transmitted to the gage, calibrated in inch-pounds. Known torques are applied by observing the gage reading while turning the lever.

The gage was calibrated in the following manner: The complete cylinder assembly was removed from the base and clamped in a horizontal position in a vise. The 10-in diameter drum *A* shown in Fig. 3 was attached to the outer end of the spindle. The cords *B* and *C* were attached to the drum at diametrically opposite points and were wound around it. The free end of cord *B* hung downward and from it was suspended a pan for holding a weight. The free end of cord *C* passed vertically upward and over the pulley *D* and then hung downward and from it was suspended another pan for holding a weight. By placing equal weights *W* in each pan, a force couple was created, the torque of which was equal to the total weight of both pans plus the two weights multiplied by the radius of the drum. The corresponding gage reading gave the first point of calibration. By increasing the weight in each pan by the same amount and noting the corresponding gage reading, the second point of calibration was found, the method being repeated to complete the entire range of the gage.

A blank face was put on the dial and was marked at each point of calibration, so that the resulting readings gave the complete range of the dial in terms of inch-pounds.

An alemite fitting was soldered into a pet cock screwed into the rear end of the cylinder so that it could be filled with oil by means of an alemite gun. The gage used had a capacity of 500 pounds.

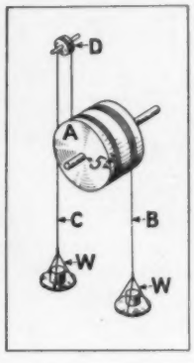


Fig. 3 — This method of applying weights was used to determine the calibration points for graduating the special dial of the gage shown in Fig. 2 to read in inch-pounds

This simple torsional testing device has proved quite useful for testing taps to destruction and should be equally useful if applied to other test specimens. Various work-holding pieces could be made to fit the spindles for accommodating other work of similar character.

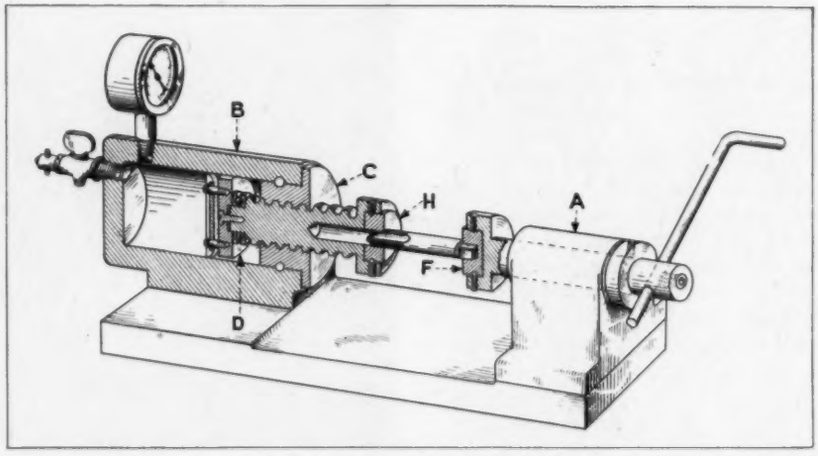


Fig. 2—For testing taps to destruction the force is applied by compressing oil in a closed cylinder. The gage reading is in inch-pounds

Hard-Surfacing Steel and Cast Iron

HARD-SURFACING, or "hard facing" is the welding to wearing parts of a facing, edge, or point of hard special alloy possessing unusual wear-resistant qualities. It protects surfaces which normally wear rapidly in service. Four types of hard-surfacing alloys for steels have been developed: These are (1) low-alloy steels, (2) high-alloy steels, (3) non-ferrous alloys, and (4) diamond substitutes. The order of preference for various uses of these alloys are given in one of the tables.

Hard-Surfacing Alloys

In selecting the correct hard-surfacing material for any application, the factors which cause deterioration of the wearing parts must first be determined. In general, the attack on the part will involve one or more of the following: sliding or rolling friction, shock and impact, heat, and corrosion. Other factors such as smoothness of deposit desired, or, in handling abrasive material such as sand, rock and gravel, the ability of the hard-face part to form an efficient tool also affect the choice. The cost factor should also be considered; when two materials are equally suited, the material giving the longer life although more expensive will more than justify its greater first cost. The tabularized characteristics of hard-surfacing deposits can be used as a fair guide in the selection of the proper material.

Hard surfacing materials can be applied by any of the standard fusion-welding methods. Gas welding gives close control over the operation and produces a smooth deposit. Scale and foreign matter are easily eliminated by this method, and edges and corners may be formed readily. Gas welding avoids the loss of expensive alloys by vaporization or spattering, permits close control of the oxidizing or reducing conditions of atmosphere surrounding the molten metal, and results in accurate control over the penetration of hard-surfacing alloy in the base metal. The latter is important with respect to the application of certain classes of hard-surfacing materials, some of which should be puddled in, while others are flowed onto the base at a "sweating" heat.

With arc welding, the metallic alloy rod constitutes both the electrode and hard-surfacing material. Flux-coated electrodes instead of bare electrodes are recommended. The coating stabilizes the arc, controls the melting rate of the electrode, protects the molten metal from contamination by atmospheric elements and in some cases adds alloys to the deposit. A weaving bead $\frac{3}{4}$ to 2 in. wide is recommended. Arc welding is particularly suitable for hard facing at low cost, and for thick base metal where thin smooth deposits are not required; in the latter case distortion is reduced since the heat from the arc is well localized.

After gas welding the part should be cooled slowly to avoid stresses in the deposited material. Less care need be taken when the base metal and welding rod are of the same composition. If very slow cooling is necessary, the hard-faced piece can be cooled under the blowpipe or torch, or in dry lime, sand or other packing material. Parts can be heat-treated to increase the strength of the base metal and to produce finer and stronger grain structure; after heating the part should be quenched in oil and normalized by cooling in air. These precautions are necessary to avoid surface cracks in the facing.

Hard-Surfacing Applications

Plain carbon and low-alloy steels can be hard-surfaced without difficulty, provided the carbon does not exceed 0.5 per cent. Higher carbon and alloy contents require in general special heat-treatment after surfacing, and preheating of the parts to be surfaced.

In the oil industry hard-surfacing is applied to drill bits; pump shafts and runners; shaft sleeves; core heads; cat-heads; side-tracking mills; and refinery valves subject to high pressures and temperatures of crudes containing free SO_2 and SO_3.

One of the most extensive applications of hard-surfaced parts is for protecting the teeth of dipper buckets, dragline buckets, clamshell buckets; digging and road machinery; tractor treads; and crushing machinery.

Other applications include automotive-engine valves subject to high temperature; brick dies; cement grinder rings; steel-mill shears; and coal undercutters.

In applying materials of Group 1 to cast iron, heat a small area at one time, and break the surface crust with the end of the welding rod. A little puddling is usually necessary and a good flux is often helpful. Because of the low melting point of cast iron, care must be taken in building up thin surfaces, edges and corners.

Alloys in Group 2 are applied to cast iron in the same manner as they are applied to steel.

Non-ferrous alloys should be applied to cast iron by gas welding, using a little less acetylene in the flame than is used for steel. The surface crust of the cast iron must be broken with the welding rod. A thin coating of the hard-surfacing material should first be applied, and this followed by building up to the required thickness. These alloys have the same melting point as cast iron, and care should be taken not to melt the base metal too deeply. If the cast iron is thin, back it up with wet asbestos or carbon paste.

Diamond substitutes are rarely if ever used to hard-surface cast iron.

CHARACTERISTICS OF HARD-SURFACING DEPOSITS

Characteristic of deposit	Group number in order of preference
Cold hardness	4 2 3 1
Red hardness	4 3 2 1
Resistance to impact	1 2 3 4
Corrosion resistance	3 2 1 4
Smoothness of deposit	3 1 2 4
Ability to take high finish	3 2 1 4
Ability to scour	4 2 3 1
Ability to penetrate (earth boring)	4 3 2 1
Thinness of welding	3 2 1 4

Group 1—Low-alloy steels.
Group 2—High-alloy steels.
Group 3—Non-ferrous alloys.
Group 4—Diamond substitutes.

Editor's Note: Material for this reference book sheet was furnished through the courtesy of the American Society for Metals and the International Acetylene Association.

Hard-Surfacing Steel and Cast Iron

SURFACE-HARDENING MATERIALS

MATERIAL	ALLOYS USED	CHARACTERISTICS	TECHNIQUE*
GROUP 1 LOW-ALLOY STEEL	Cr Mn Mo V W	Has less than 20% of alloying elements Carbon range, 0.3-0.6 per cent Low cost Not as hard as group 2 Relatively short life in service Are work hardening Very tough and shock resistant	Deposit $\frac{1}{16}$-$\frac{1}{4}$ in. deep; penetrate base metal 0-$\frac{1}{32}$ in.; surface cracks eliminated by heating to red heat and adding new metal *Gas welding:* always use excess of acetylene; high excess of acetylene and slow cooling rate gives high hardness *Arc welding:* rod positive, work negative; use high current; bead should be flat and weaved; weld in flat position *Finishing:* shaped partially in plastic state; scrap off and level by heating to 200-300 F. with blow pipe; peen to eliminate surface cracks; grind
GROUP 2 HIGH-ALLOY STEEL	Cr Mn Ni W Co	Has more than 20% of alloying elements More costly than group 1 Very hard and good abrasive qualities Not as tough and shock resistant as group 1 Frequently more economical than group 1 because of longer service life Penetration of base metal has no effect on quality of deposit Arc welding produces high-carbon steel that cannot be machined unless annealed	Deposit $\frac{1}{16}$-$\frac{1}{4}$ in. deep; for greater deposit build up first with materials of group 1 *Gas welding:* use neutral or slightly carburizing flame; melt the base metal; sweating not advisable *Arc welding:* rod positive, work negative; use wide or narrow bead; wire brush each bead; peening sometimes hardens deposit; weld in a flat position; water quench sometimes gives high hardness *Finishing:* same as group 1
GROUP 3 NON-FERROUS ALLOYS	Cr Co W	High resistance to wear and corrosion Retains hardness at high temperatures Strength and toughness makes these suitable for wide range of uses	Apply without penetrating base metal; deposit $\frac{1}{16}$-$\frac{1}{4}$ in. deep; for greater deposit build up first with material of group 1 *Gas welding:* use excess of acetylene; outer cone of flame should be twice as long as inner cone; material applied by sweating; rod should not be stirred or puddled; build up in one operation; no flux necessary when steel is clean *Arc welding:* coated rods preferred; rod positive, work negative *Finish:* grind at 2800-4200 surface ft. per min. to avoid grinding cracks
GROUP 4 DIAMOND SUBSTITUTES		Pure fused tungsten carbides, of 90-95% tungsten carbides plus remainder of Co, Ni, Fe, boron compounds or tantalum carbide, which impart toughness to the tungsten carbide High abrasion and maximum cutting qualities Used as inserts in base metal or applied like welding rod when bonded with electrode or welding strip; also furnished in granular form for sprinkling on heated base metal Most costly of all groups Long life under severe service	Size and space of insert varies for different service applications; generally applied by gas heating; inserts are set in molten puddle; base metal grooved for inserts; cover inserts with welding rod Apply when in tube form by using gas flame with small excess of acetylene; do not penetrate base metal excessively; stir the rod slightly; avoid too long a molten stage; use low gas pressure and large tip to avoid blowing the molten metal For finishing use grinding wheels designed especially for these materials; when grinding, avoiding glazing or checking by frequent dressing of the wheel

* Steels with over 0.40 C should be preheated at 700-1200 F.

Not Beer and Pretzels

INDUSTRIAL PRODUCTION hit a ten-year high in October. November is expected to be even higher. Yet no one is so brash as to suggest that real prosperity is here, that we are on the road to permanent business recovery.

Therein lies the great promise in the present situation. Industrialists are realistic about conditions. They recognize that the war influence permeates the country; and the war influence is an artificial stimulus which may end anytime.

Business is cautious about expansion of plant capacity. And that's a healthy sign. For it shows an awareness that prosperity as we have known it in the past decade is an ephemeral sort of thing, which is here today and gone tomorrow. If you start to build new capacity while order books are overflowing, you may not need it by the time the brick and mortar and machinery are in place.

Industry, in cooperation with government, is throwing its weight on the side of keeping prices from rising too much or too fast. Admittedly special cases exist where prices have had to go up, but fortunately no runaway price movement has developed. And that fact may help cushion any shock to the industrial system growing out of a sudden end to the European war.

Then there is the question of how much war business actually will be placed in this country, and how much that business will offset dislocation of trade in peacetime products. Analysis of the prospects leads to the conclusion that war buying, outside of airplanes and machine tools, may be far less than is generally believed. Doubt also exists whether such buying can compensate for the temporary loss of foreign markets for many commodities dependent on normal demands for their consumption.

Piled on top of the war's distortion of industry's activities is the national defense program. Expenditures running into billions are contemplated. If it be granted that such a vast outlay is desirable, nevertheless it represents a form of pump-priming. It isn't as healthy a stimulus from industry's standpoint as expansion caused by normal pick-up in demand for capital goods.

And what about the day when war ends and the present unbridled armament race comes to a halt? From that day on, U. S. manufacturers, particularly in the metal-working industry, will be dependent upon the home market for whatever prosperity they may enjoy. Fortunately, again I say, industrialists aren't so immersed in war orders that they are not keenly aware that such a day is drawing nearer.

Despite the fact that industry is whooping up operations at a pace heretofore not attained since the twenties, many disconcerting problems continue to plague us. The national debt, already at a peak, is still pyramiding. Unemployment for some nine million people still exists. Confidence in the government, which is the bedrock upon which prosperity builds, is lacking on the part of industry. Employer-employee relations are not what they should be. "Isms" and all kinds of pressure blocs are still rampant.

It seems obvious, from a quick look around, that everything isn't beer and pretzels, even if industry at the moment is zooming. Let's remember that fact, no matter how busy war may temporarily make us.

Burnham Finney

GAGING BUSINESS

Huge wartime contracts, backed up by heavy orders for peacetime products, will result in one of the busiest winters in metal-working history.

The metal-working industry is heading into one of the busiest winters in history. Cushioned by a huge backlog of orders from the allies, from other foreign countries and from the United States Government for national defense purposes, plants are running at top speed or close to it. Further business tinged with war influence is in the offing. Reinforcing these bookings is a substantial volume of orders for peacetime products. The frenzied atmosphere which prevailed for two months after the declaration of war has been gradually replaced by a more quiet and orderly situation. The first quarter outlook is better than it was two weeks ago.

MACHINE TOOLS—French and British purchases have been heavy. The amount of Russian and Japanese business also has been formidable. Army and navy contracts let to machine tool builders for arsenal and navy yard installations have become of increasing importance. The navy alone has just awarded almost $500,000 to two companies for planers. Because they cannot secure deliveries for from six months to more than a year, some domestic users are holding back tooling and modernization programs. They are not confident enough of what conditions may be that far ahead to commit themselves on long-range purchases. Certain automobile makers are refusing to place orders unless they can get machines within four months. Big sales are still being made to the aircraft industry. Having operated at 84.9 per cent of capacity in October, machine tool builders have been endeavoring to push the rate even higher. As a general rule they are fighting shy of major plant expansions. Instead they are running two and three shifts, are applying every practical method of increasing plant efficiency, and are farming out contracts for parts to local job shops.

AIRCRAFT—The industry is working feverishly in an effort to make a dent in its backlog of approximately half a billion dollars of orders. Capacity now is 15,000 planes a year, with further enlargement planned. Present operating rate, however, is believed far below the stated capacity though output will be increased as rapidly as possible. The British have bought a large number of training planes in this country. The U. S. War Department has contracted with Pratt & Whitney Aircraft for engines valued at $12,834,105. Allison Engineering and Continental Motors have received smaller awards for aircraft engines.

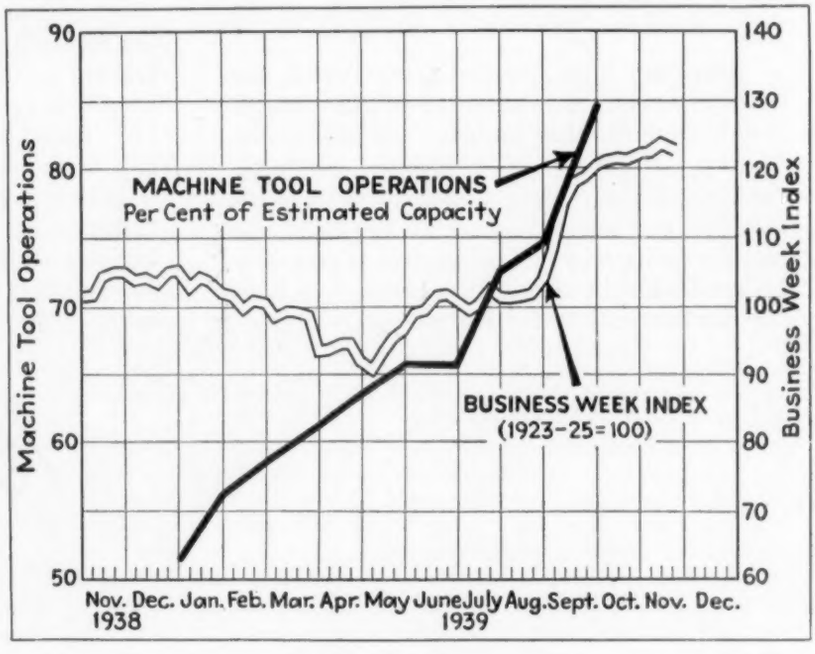
RAILROAD EQUIPMENT—After the bulge of orders the past 60 days, new awards have dropped sharply. Elgin, Joliet & Eastern has applied for I.C.C. authority to buy $6,000,000 of equipment, including eight diesel locomotives and 2,000 freight cars. Northern Pacific is asking the R.F.C. to purchase notes to finance 1,600 freight cars costing $5,560,000. Pullman-Standard is opening its Curtis Bay plant at Baltimore, idle since 1936, to fill an order from Brazil for 500 freight cars.

STEEL—Mills have not deviated from their all-time record rate of operations. Incoming business is sufficiently large to insure heavy production during the early part of 1940, on top of full capacity output during the remainder of this year. Prices will be mainly unchanged from present levels in the first quarter. Strongest demand still is for sheet and strip steel. Substantial orders for steel for freight cars are expected soon.

FARM IMPLEMENTS—Manufacturers are gradually stepping up output as they begin stocking dealers with their spring needs. Tractor production is proceeding at a steady pace. General Motors will furnish its diesel engines to power the heavy-duty tractors of one company. Montgomery Ward is reported to have signed a contract to sell the complete line of farm equipment of B. F. Avery & Sons Co., Louisville. Heretofore it has handled only a limited line of implements made by Oliver Farm Equipment Co.

MACHINE TOOL OPERATIONS VS. GENERAL BUSINESS

Machine tool operations for October were at 84.9 per cent of capacity, according to the new index issued by the National Machine Tool Builders Association. The index, representing approximately 60 per cent of the industry's volume, is based on productive hours expressed as a percentage of the estimated total capacity of the companies reporting



NEWS OF THE INDUSTRY

CHRYSLER STRIKE NETS UAW LITTLE; CIO LEADERS IRKED

DETROIT—Out of the Chrysler strike, which began Oct. 6, the union stands to gain little. It will get slightly higher wage rates, according to reliable reports, but not enough to make up for the losses in income by the men while idle for weeks. A few other concessions are assured. Chrysler, however, will not surrender any vital rights such as the right to run its own business without union interference. The union started out demanding a closed shop and control over rate setting, but abandoned these issues after several weeks had passed.

Chrysler has been adamant on one point—it insists that the UAW divorce itself completely from organization of a foremen's union. Renouncing of CIO'S interest in foremen and supervisors should come in the form of a public pledge by John L. Lewis or some other high-up union official, not from the UAW. Chrysler contends that if the union has both workers and foremen in its ranks, then the union will sit on both sides of the bargaining table, since foremen are representatives of the management.

CIO national officials, so reliable reports go, are greatly irritated about the UAW's use of the slowdown and privately say that it will not be employed again if they can help it. They realize only too well the unfavorable public reaction to this strike technique.

General Motors executives are known to be nervous about whether the UAW will try to move in on the corporation immediately following the Chrysler settlement. There appears good reason to believe that Walter Reuther, leader of the UAW-GM union forces, will go just as far as he can to secure concessions from General Motors without actually precipitating a strike.

Despite the general impression that Mayor-elect Edward Jeffries of Detroit has union sympathies and bore the CIO endorsement, automotive leaders claim the industry will get a square deal from him. He is a young man of great ability and has built a reputation for fairness. The day following the election the Detroit Free Press, Conservative Detroit Daily, carried a leading editorial praising him highly.

Tax Concessions and Premiums Proposed To Spur Expansion of Munitions Plants

Plan Would Promote National Defense Through Greater Reserve Capacity

WASHINGTON—To secure the cooperation of companies making munitions and other products of vital necessity to national defense, the federal government has put into operation a plan for tax concessions and for paying premiums for materials which will make it possible for manufacturers to write off new plant and equipment purchases in a short time.

The plan is being applied first to the Colt Patent Firearms Co. Another company which will secure aid under this plan is Allison Engineering Co. of Indianapolis, which has large orders for the Army's first liquid-cooled aircraft motor.

Though details of the plan are not available, the general program is for the Army and Navy to contract for materials at prices which will allow manufacturers to add to plant facili-

NAVY BUYING PROMINENT

WASHINGTON — Consolidated Machine Tool Corp., Rochester, N. Y., and General Machinery Corp., Hamilton, Ohio, have each been awarded contracts for planers for the United States Navy valued at $248,550. The Pressed Steel Tank Co., West Allis, Wis., has received an order from the Navy for shells costing $59,250. Lukenweld, Inc., Coatesville, Pa., will supply the Navy with slides, carriages and base rings at cost of $44,856.

Crane Co., Washington, D. C., received a contract for pipe fittings amounting to $77,613. Higgins Industries, Inc., New Orleans, La., was awarded a $62,525 contract for 30-ft. boats, and Penn Galvanizing Co., Philadelphia, Pa., $24,590 for steel shapes.

British Combine

Defense

An important item in Britain's defense program is production of anti-aircraft guns, which have been developed to a point of perfection undreamed of in the last war. Here mechanics in a British ordnance factory put the finishing touches on a late model 3.7

Around the Corner—*Employment, if not prosperity, is just around the corner for many of these young men outside the Douglas Aircraft plant in Santa Monica, Calif. The company, whose experience is typical of most of the industry, set an employment record in October, when 1,600 persons were hired. Officials expect 12,000 to be on the payroll by Jan. 1, and 17,000 by June*

ties. The bureau of internal revenue would grant tax concessions to permit companies to write off new plant and equipment purchases.

Reports state that the government is not averse to such a plan applying to companies dealing with the Allied governments too, wherever such expansion of plant capacities will later be beneficial to U. S. defense. A case in point is said to be the apparent willingness of the French to pay a large premium for considerable purchases of powder which will make necessary the expansion of plant capacity here. The administration is known to feel that powder manufacturing facilities are now inadequate to meet growing needs for national defense.

The French and British are reported to have advanced $5,000,000 to aircraft engine makers to enlarge their plant capacities so they can speed up deliveries to the Allies.

The Navy is understood to be ready to grant similar aid to armor plate manufacturers. The way the tax concessions will work is that greater depreciation allowances than normal will be applied against the taxable income of manufacturers, thus speeding amortization of expenses for plant additions and for new equipment.

TOOL & DIE MAKERS COVERED

WASHINGTON—Makers of tools, dies, patterns, designs, blueprints, etc., which do not move into interstate commerce but which are used in the production of goods for interstate commerce, are subject to the wage-hour law. An interpretative bulletin to this effect was issued Nov. 24. Attention was called to the exemption provided in the law for "professional" employees which "might apply to some designers."

NEW MACHINE TOOL INDEX ISSUED

CLEVELAND—The machine tool industry operated at 84.9 per cent of capacity during October, according to the new Index of Operating Rate for the Machine Tool Industry compiled by the National Machine Tool Builders' Association. This figure compares with 74.6 per cent in September and 52.5 per cent in January, 1939. Representative of about 60 per cent of the industry's volume, the index is based on productive hours expressed in percentage of an estimated total capacity of the reporting companies. Operations for the year follow: January 52.5 per cent; February 56.1; March 58.7; April 61.2; May 63.6; June 65.5; July 65.8; August 72.6; September 74.6 and October 84.9.

U. S. Government Contracts Awarded to Metal-Working Firms

(Machine Tool Contracts on Page 1038)

Contractor	Gov't Agency	Commodity	Amount
Midvale Co., Philadelphia, Pa.	Navy	Gun forgings	$1,879,536
Baldwin Southwark Corp., Eddystone, Pa.	Navy	Forgings	34,009
Budd Wheel Co., Detroit, Mich.	Ordnance	Shells	193,257
Winchester Repeating Arms Co., New Haven, Conn.	Ordnance	Rifles	8,700,000
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.	Ordnance	Pistols	68,122
Ingersoll-Rand Co., Painted Post, N. Y.	Panama Canal	Air compressors	121,003
Whiting Corp., Harvey, Ill.	Interior	Traveling cranes	167,750
American Hoist & Derrick Co., St. Paul, Minn.	TVA; Panama Canal	Derricks, cranes	186,678
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	TVA	Circuit breakers	14,845
North Coast Electric Co., Seattle, Wash.	Navy	Cable	45,830
John A. Roebling's Sons Co., Trenton, N. J.	Navy	Electrical cable	46,213
Bendix Radio Corp., Baltimore, Md.	CAA; Signal Corps	Radio equipment	899,297
Kellogg Switchboard & Supply Co., Chicago, Ill.	Signal Corps	Sound equipment	74,818
Ballantine Laboratories, Inc., Boonton, N. J.	Signal Corps	Sound equipment	86,621
United Aircraft Corp., East Hartford, Conn.	Navy	Airplanes and parts	2,111,983
American Car & Foundry Co., New York, N. Y.	Navy	Railroad cars	73,921
Bausch & Lomb Optical Co., Rochester, N. Y.	War, Ordnance	Stereoscopic trainers	83,699
Kollmorgen Optical Corp., Brooklyn, N. Y.	Navy, S. & A.	Sights, drift	54,000
Goslin-Birmingham Mfg. Co., Birmingham, Ala.	Interior	Conduit liner	128,000
National Forge & Ordnance Co., Irvine, Pa.	Navy	Plungers, cylinders	45,425
Allis-Chalmers Mfg. Co., Milwaukee, Wis.	Air Corps; Interior; TVA	Dynamometer bedplates, circuit breakers	112,707
Aluminum Co. of America, Pittsburgh, Pa.	TVA	Electrical conductor	263,679
Leece-Neville Co., Cleveland, Ohio	Navy; Air Corps	Diesel parts, panels	51,959
Thew Shovel Co., Lorain, Ohio	Panama Canal	Shovels	158,400
General Electric Co., Schenectady, N. Y.	Navy; TVA	Electrical equipment	39,903
J. H. Bennell & Co., Brooklyn, N. Y.	Signal Corps	Radio equipment	35,791
Grumman Aircraft Engineering Corp., Bethpage, N. Y.	Navy	Airplane parts	12,715
Douglas Aircraft Co., Santa Monica, Calif.	Navy	Airplane parts	13,984
Eclipse Aviation Div., Bendix Aviation Corp., Bendix, N. J.	Navy	Starters	19,778
Luders Marine Construction Co., Stamford, Conn.	QMC	Box boats	123,500
General Electric Co., Schenectady, N. Y.	Panama R. R. Co.	Locomotives	438,750
American Locomotive Co., Schenectady, N. Y.	Panama R. R. Co.	Locomotives	221,600
Pioneer Instrument Co., Bendix, N. J.	Air Corps	Aircraft instruments	573,990
RCA Mfg. Co., Camden, N. J.	Navy	Motion picture equipment	112,256
Steel & Tubes Div., Republic Steel Corp., Cleveland, Ohio	Ordnance	Burster assemblies	197,105
Chase Brass & Copper Co., Waterbury, Conn.	Ordnance	Cartridge cups	27,690
Revere Copper & Brass, Inc., Detroit, Mich.	Ordnance	Gilding metal	58,110
General Electric Co., Schenectady, N. Y.	Navy	Electrical equipment	35,649
Okonite Co., Passaic, N. J.	Navy	Electric cables	24,853
General Cable Corp., Perth Amboy, N. J.	Navy	Electric cables	66,677

INSIDE DETROIT

By Rupert Le Grand
DETROIT EDITOR

Several automobile companies plan extensive expansion programs. New additions to lines and additional plants to make subassemblies are contemplated

DETROIT—Good business has so enlivened the automobile companies that one hears of expansion projects of all sorts. Several concerns are reported figuring on such diverse undertakings as new additions to the line, new transmission plants, and a general rounding out of productive capacity.

Hottest project right now is the new Nash light six which will be competitive with Chevrolet and Plymouth. This car cannot be introduced before the 1941 season, but it is known that the management has committed itself to put the new model on the market. The Nash plant is working only one shift at present, and much idle capacity could be tooled up. Not so promising at the moment are the prospects for a new Studebaker light six. But that company is likely to put in its own transmission department, figuring that it can make the gearbox cheaper than buying it from Borg-Warner.

Present indications are that Packard will not bring out the light six for which it started a die program last spring, and for which the major part of a $5,000,000 tooling-up program had been earmarked. It is understood that Packard is thinking right now about buying a few machines to round out its production system, rather than to go ahead with a lower-priced model. Daily output has been running within a couple dozen cars of the absolute peak. When Chrysler gets going again, Packard as well as others will probably not be so pressed with unfilled orders.

Just Misses a Record

The automobile industry missed the opportunity to chalk up a new production record during November, because Chrysler was out of the running. Without this important producer, the industry total for cars and trucks, U. S. and Canada, is estimated at 390,000 units. This is equal to the output during November, 1938, and is 15 per cent ahead of October, 1939.

Chrysler's loss for the 21 working days of November should amount to about 100,000 units. If all these could be added to the above estimate, November would have been approximately 20 per cent ahead of the same period of 1935 and 1936. It must be realized, of course, that the present selling season is actually one month more advanced than last year.

Employment in the auto parts industry has not suffered as much as might be expected because of the Chrysler shutdown. Other car manufacturers are working to capacity, although they are apparently not trying to take serious advantage of their competitor's position. But the auto parts industry began the fourth quarter with good prospects of exceptional profits, and certainly Chrysler's loss of 180,000 cars during October and November is going to cut considerably into projected earnings.

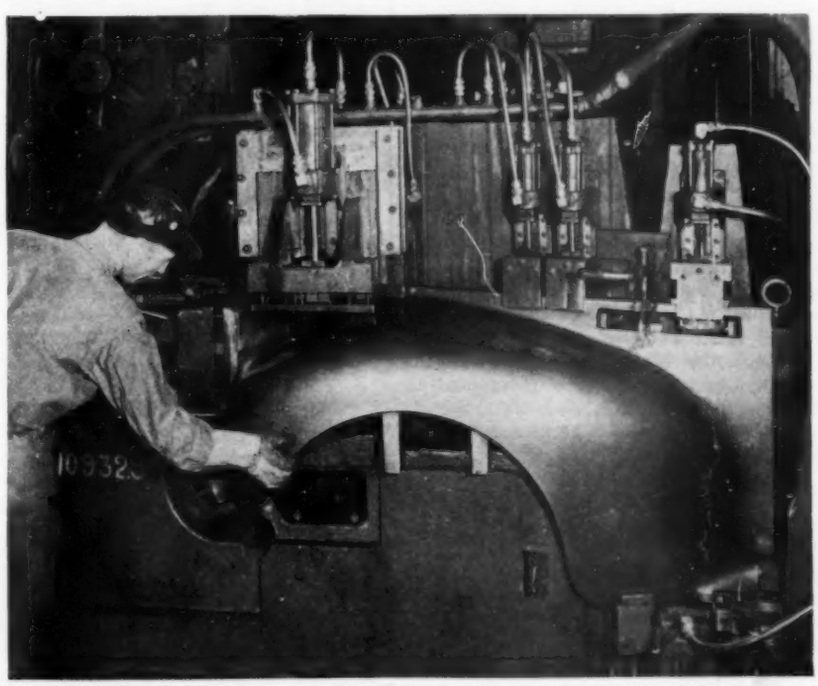
Only nominal steel tonnage has been placed for next year by the automotive industry. Consumers are waiting for the price announcement, which is expected shortly, and which is believed will call for sheet and strip prices at the present level. Many steel customers already have on hand considerable tonnage for use in the early months of the year.

Immediate Future Bright

National defense may be a bogey athwart the path of the automotive industry, but the immediate prospect is refreshing. Dealers' stocks of new cars are steadily dwindling. Whereas, two weeks ago, the new-car stocks of major suppliers were in the order of ten days to two weeks supply, they are said now to be at one-week level

AUTOMOTIVE TOOL BUYING DROPS

DETROIT—Inability of machine tool companies to make deliveries within a reasonable time limit after orders have been placed is working to the detriment of future business from automotive companies. Most motor car makers have laid down an arbitrary rule that they will not place equipment orders, except for large highly special machines, unless they can get delivery within four months. On that basis a number of lucrative orders have "gone by the board" in the last few weeks. During most of the past decade Detroit has been the richest source of machine tool business. That is not true today. Less volume of purchases is passing through local offices than in several years.



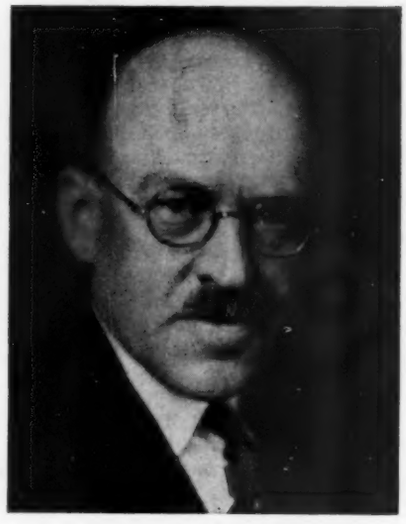
Three in One—*Advanced press shop technique makes it possible to form Buick front fender, hood side and headlamp body from one piece of steel. Original sheet is 0.048 in. thick and measures just under 5x8 ft. After several drawing and annealing operations, the part is finish trimmed and flanged. All holes are then hydraulically pierced in the fixture above*

Hot Spot

Roller bearing race is made integral with this automobile hub by a heat-treating process developed by Budd Induction Heating, Inc. Machine head, lowered into hub bore, heats the surface to a high temperature by induction. Water forced through a quenching fixture completes the operation. Only a second or two is required for each cycle, which prevents decarburization and minimizes oxidation

FLANDERS NAMED TO FEDERAL COMMITTEE ON APPRENTICESHIP

WASHINGTON—Ralph E. Flanders, president Jones & Lamson Machine Company, Springfield, Vt., has been appointed representative of management of the Federal Committee on Apprenticeship, which has recently been enlarged to provide broader representation to management and labor in the formation of apprenticeship policies. Clinton Golden, Eastern regional director of the Steel Workers Organizing Committee, has been named representative of labor.



RALPH E. FLANDERS

Mr. Flanders has been a member of the Business Advisory Council of the Department of Commerce and a member of the Industrial Advisory Board of the NRA. He is also a director of several other machine tool companies, and has written a number of papers, among the most prominent of which are "Taming Our Machines" and "A Platform for American Industry."

or less. Used-car stocks, while growing, are at about a three-weeks supply, as compared to six weeks during average fall selling seasons.

The used-car situation is difficult of a true statistical analysis, but the records of certain producers show that the present position does not call for a serious letdown in production during the winter. Chevrolet dealers had about 90,000 used cars on hand, but there is plenty of slack between that number and the normal of 140,000 by spring. Pontiac outlets sold more used cars during the first ten days in November than in the comparable October period. Inventories are higher, but the announcement was a month later last year. Nash used-car stocks are 50 per cent higher than at this time last year, but the increase in new-car sales has outstripped the gain in second-hand vehicles. In general, it can be said that employment and income throughout the country are better than last fall, and that the used-car buyer is a stronger factor in the market.

GETS MILLION-DOLLAR ORDER

WASHINGTON—The Ordnance Department of the U. S. Army has awarded a contract to Continental Motors Corporation, Detroit, for a large number of tank engines and parts, which will cost approximately $1,000,000.

This is in addition to a recent order received by the same concern for $294,000 worth of Model R-670-5 aircraft engines developing 220 hp.

ARMY BUYING HEAVY

WASHINGTON — Allison Engineering Co., Indianapolis, division of General Motors Corp., has received an order from the U. S. War Department for Model 7-1710-35 aircraft engines of 1,150 hp. costing $1,851,631. Jacobs Aircraft Engine Co., Pottstown, Penna., will furnish the Army model R-755-7 aircraft engines valued at $360,000. Spencer Lens Co., Buffalo, N. Y., will supply azimuth instruments with spare parts to the War Department at cost of $116,200. Mack International Motor Truck Corp. will build 80 trucks of 2½-ton capacity for the Army at a cost of $123,280.

U. S. Government Contracts Awarded to Machine Tool Makers

(Other Metal-Working Contracts on Page 1008d)

Contractor	Gov't Agency	Commodity	Amount
Wm. Sellers & Co., Philadelphia, Pa.	Navy	Boring machine	$39,422
Jones & Lamson Machine Co., Springfield, Vt.	Ordnance	Grinding machine	11,644
Bryant Chucking Grinder Co., Springfield, Vt.	Navy	Grinding machine	12,325
Hendey Machine Co., Torrington, Conn.	Navy, Ordnance	Lathes	57,129
Morton Mfg. Co., Muskegon Heights, Mich.	Navy	Shaper	50,500
Universal Boring Mill Co., Hudson, Mass.	Ordnance	Boring mills	55,548
Gisholt Machine Co., Madison, Wis.	Ordnance, Navy	Turret lathes	48,157
Brown & Sharpe Mfg. Co., Providence, R. I.	Ordnance	Milling machines	27,220
Warner & Swasey Co., Cleveland, Ohio	Ordnance	Turret lathes	12,856
Bunell Machine & Tool Co., Cleveland, Ohio	Air Corps	Propeller tools	27,954
Pratt & Whitney Div., Niles-Bement-Pond Co., Hartford, Conn.	Ordnance	Thread gages	13,634
New Britain-Gridley Machine Div., New Britain Machine Co., New Britain, Conn.	Ordnance	Chucking machines	23,130
Seneca Falls Machine Co., Seneca Falls, N. Y.	Ordnance	Lathes	26,085
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.	Ordnance	Boring mills	128,988
Leland-Gifford Co., Worcester, Mass.	Ordnance	Drill presses	15,643
King Machine Tool Co., Cincinnati, Ohio	Navy	Turret lathe	15,859
E. W. Bliss Co., Brooklyn, N. Y.	Ordnance	Presses	12,100

Conferees—*Prominent in the activities of the production division of the American Management Association, at its meeting held Nov. 15–16 in Chicago, were A.M.A. president Alvin E. Dodd, left; Kirke W. Connor, president Micromatic Hone Company, center; and Raymond S. Perry, vice-president Ingersoll Milling Machine Company, right. New plant construction was a major topic*

Production and Plant Facilities Discussed At American Management Association Meeting

CHICAGO—Several hundred plant engineers and executives gathered in one of this city's most efficiently organized hotels Nov. 15–16 to discuss ways of making possible the best use of existing plant facilities and of providing flexible expansion with new developments in building and equipment.

Raymond S. Perry, vice-president Ingersoll Milling Machine Co. and chairman of the conference planning committee, opened the meeting by pointing out that studies had indicated that plant equipment in this country is being utilized to about 70–75 per cent capacity. However, it would be wrong to conclude that there was no great need for increased production capacity as buildings and equipment become obsolete in one form or another every year and there is always the element of growth which requires new facilities.

Two Types of Growth

Mr. Perry pointed out the need for recognizing the difference in "competitive growth" and "industrial growth" when expansion is being considered. While adding men to the payroll is the obvious way of expansion, very few plants have the necessary balanced production units—for instance, in a plant making lead pencils the department making the leads should produce the same number of units as the department making erasers when each is manned with a full shift. In the automotive industry most of the producing units figure on a normal year to give them full time operations on one shift basis and production facilities are made to meet these requirements, while the second and third shifts carry it through the peak production periods. Other methods of handling expansion is by contract work, capital outlay in bottleneck departments, and general plant expansion.

Discounts Value of Exports

In discussing present industrial activity Mr. Perry said, "It seems perfectly clear to me as an individual that the export stimulus is a temporary one and may cease at any moment. There doesn't appear to be any evidence available that our country, in a domestic market, will support the added production facilities that we may add at the present time because of export stimulus.

"It does seem to me, however, that we are being given a rare opportunity to take advantage of a high rate of industrial activity to justify our present production facilities and modernize our plants throughout."

Trends in lighting, heating, ventilating, and buildings were brought out in the succeeding talks. Louis Kahn of Albert Kahn, Inc., warned that the "temporary" building of today usually becomes the permanent building of tomorrow so that a little additional expenditure for a good building is desirable at the outset.

Elaborate vs. Adequate Buildings

H. K. Ferguson said that a building should be only good enough to keep maintenance costs low, as its prime purpose is to protect a process from the elements and not to serve as a monument. He recommended that any production layout be engineered to break even at 50 per cent capacity. In closing Mr. Ferguson recommended the formation of a division of plant engineers in the A.M.A. which could exchange practical ideas and serve as a clearing house on costs of maintenance.

G. K. Simonds, Sr., general manager Simonds Saw & Steel Co., and W. J. Austin, The Austin Co., presented the practical features of the new Simonds windowless plant where all working conditions are under control. Fluorescent lamps, 1,440 in a five-acre plant, provide constant light of 20 candlepower 24 hours a day, making true straight-line production possible, at a cost of about $1.50 per hour. Mr. Simonds emphasized that the costs of good lights, air conditioning, dust control, and washrooms are infinitesimal in view of the benefits gained. Good lighting alone increased production and the gain in "daylight" hours gives several times as much use from a machine before obsolescence.

Better Lighting Discussed

The trend toward improved lighting, particularly in the use of fluorescent light, was emphasized by S. M. Brown, Hygrade Sylvania Corp., in describing new plants of his company. An entire session was devoted to lighting as a production tool, W. C. Brown, General Electric Co., being the main speaker. R. S. Iremonger, Benjamin Electric Co.; A. L. Powell, General Electric; Harris Reinhardt, Westinghouse Electric & Mfg. Co.; D. H. Tuck, The Holophane Co.; and L. C. Morrow, *Factory*, discussed lighting levels, ultraviolet light for inspection, flexible installations, sodium lamps, mercury-mazda combinations and other various topics.

Solutions of production problems by application of modern heating, ventilating and air-conditioning equipment, and the effect of atmospheric conditions on employee efficiency were subjects for other sessions. George Begoon, Westinghouse Electric & Mfg. Co., demonstrated new methods in air cleaning.

WATCHING WASHINGTON

McGraw-Hill Washington Bureau

PAUL WOOTON, CHIEF

Special House committee plans NLRB investigation, seeking specific infractions of law. Congress again directs its attention to matters other than national defense

WASHINGTON—Remember the special House committee that was rigged up in Congress last year to investigate the Labor Relations Board? And how it took the wind out of the sails of the House Labor Committee, which was already probing the law and the Board with an eye to revisions? Well, the special committee is preparing to start open hearings, probably about Dec. 1. The inquisitors will seek specific infractions of the law by the Board, and will spotlight all the dirt it can find. Although the committee has no power to recommend legislation, its findings undoubtedly will be used as the basis for proposed amendments. Meanwhile the question whether a federal court can modify an order of the Board, or must accept or reject it as it stands, seems destined for decision by the Supreme Court, which has agreed to review the Board's appeal in its action against the Falk Corporation. Both the government and the company are asking for a decision.

Steel Probe Explained

TNEC hearings on steel are complicated. If you're mixed up here's the nutshell story: The second of a series of three hearings has just ended. It was conducted by the Department of Justice, and it related to steel pricing policy. The first hearing, held last March, was by the Federal Trade Commission and dealt with abolition of the basing point system and the substitution of the FOB mill system of quoting prices. Third and final hearing will be some time in January, jointly by FTC which will go farther into basing point practice, and by Justice which will investigate costs and distribution. This huge expenditure of conversation is expected to result, some day, in revision of the antitrust laws, permitting oil, steel, and such industries having a few units, to operate "competitive monopolies"—under government control.

Additional Education

Within a few days Army will award educational orders on bids just received for aircraft flares and gas masks. Goodyear got the original gas mask order last year, so is not eligible to receive the next. Airplane flares are the calcium lights which are dropped on small parachutes to light the ground for forced landing. Flares for civil planes have been manufactured commercially for many years, but the making of military flares, more powerful and complex, requires experience which hardly any private plants have had.

Wage-Hour Division Streamlined

First definite indication that Colonel Philip Fleming is actually running the Wage-Hour Division of the Labor Department, as he said he would, is an announcement by him that the Division has been reorganized to obtain quick administrative decisions. Fleming's news handout merely quotes him by name as authority for the change, without reference to his non-existent title. The acting administrator, Harold Jacobs, is not mentioned. Reorganization elevates three wage-hour sections to a higher status, reporting directly to the Administrator's office. It sounds like Washington's old bureaucratic chess game again.

1940 TAXES? SAME

There will be no general tax revision in 1940. This is the conclusion of both President Roosevelt and Senator Harrison, chairman of the Finance Committee. Such statements in previous years have often been followed by tax bills, as it has always been sound political practice to make out there was no need for higher taxes.

This time the prediction will stand for a reason much more important than the one Roosevelt and Harrison are giving the public: Political parties when in power seldom boost taxes right on the eve of a national election. This is important to remember not as a lesson in political expendiency, but because the situation just stated is what will control the tax situation in 1940—NOT the President's intent to hold down all federal expenditures except those for national defense. The President does want this done, but the chances of its being accomplished are about one in twenty.

Pushover

A smart scheme for getting American-made airplanes across the border to Canada, has been thought up by enterprising manufacturers. The State Department says planes may be flown to the border, and thence must be shipped. But it doesn't say the planes can't be *rolled* across, so the bright-eyed boys are looking for a nice big meadow conveniently spread over the border so ships can be landed, rolled over the 50-yard line, and flown off again. Report persists there will be a big transatlantic flyaway delivery in the spring, a new sight in the world.

Little Steel Still Struggles

The Justice Department is carrying the District of Columbia Court of Appeals' "narrow" definition of the "little steel case" to the Supreme Court. Government attorneys will ask the high court, if it accepts the issue, to set the date ahead for argument, on the ground that the decision has rendered the Walsh-Healey Act virtually inoperative on government purchase of steel for national defense. It will be recalled that the case was brought by seven small steel firms, which held that the Secretary of Labor had acted illegally and arbitrarily in dividing the country into six regions for fixing minimum wage rates under the public contracts law. The action was enjoined by "little steel" with plants in Pennsylvania, Maryland, and Connecticut.

Defense Sidelights

Maritime Commission's shipbuilding program is going great guns, but don't be surprised if it comes in for criticism soon; argument will be that there's no point in spending hundreds of millions on a merchant fleet while the Neutrality law scuttles trade routes . . . . House Naval Affairs subcommittee left on a junket Southward to study advisability of reopening the New Orleans navy yard and establishing an air base at Corpus Christi . . . . Any cessation of the Nazi threat would bring immediate economy attacks on national defense in this country; Secretary of War Woodring is already having trouble with the Budget Bureau over his proposal to spend about one and a half billions in 1941; many people want to know whom we are going to fight with all this war gear . . . . Scattered talk that the Government should boycott manufacturers who sky-rocket prices still persists, but no legislation is expected; government agencies could, nevertheless, put the squeeze on unruly manufacturers . . . . Senator Elbert D. Thomas, of Utah, wants the Government to spend strategic minerals funds in Navada, developing manganese deposits.

CANADIAN ARMAMENT ORDERS LAG; BUYING EXPECTED SOON

OTTAWA—Orders for shells, gun barrels and mechanized equipment for war use are to be placed shortly with Canadian automobile and farm machinery companies. Actual contracts awarded recently, however, have been less than manufacturers had anticipated.

Some 400 training planes have been bought from the North American Aviation Corp. by the British Air Ministry for delivery to Canada. Two hundred more training planes will be purchased soon. Pressure is reported to have been brought on the Canadian government by the Empire to pay a considerable share of the cost of building airdromes and other facilities, over and above the original amount planned. The reason is that Canada will have the use of such facilities after the war. England still is slated, however, to pay the biggest single share of the total cost.

Construction of mine sweepers, anti-submarine boats, ships for convoy work and freighters is expected to get under way soon. Delay is attributed to desire to utilize British blueprints which have not yet arrived. Ships built to British specifications will have the advantage of latest engineering developments and of being capable of quick repair on either side of the Atlantic.

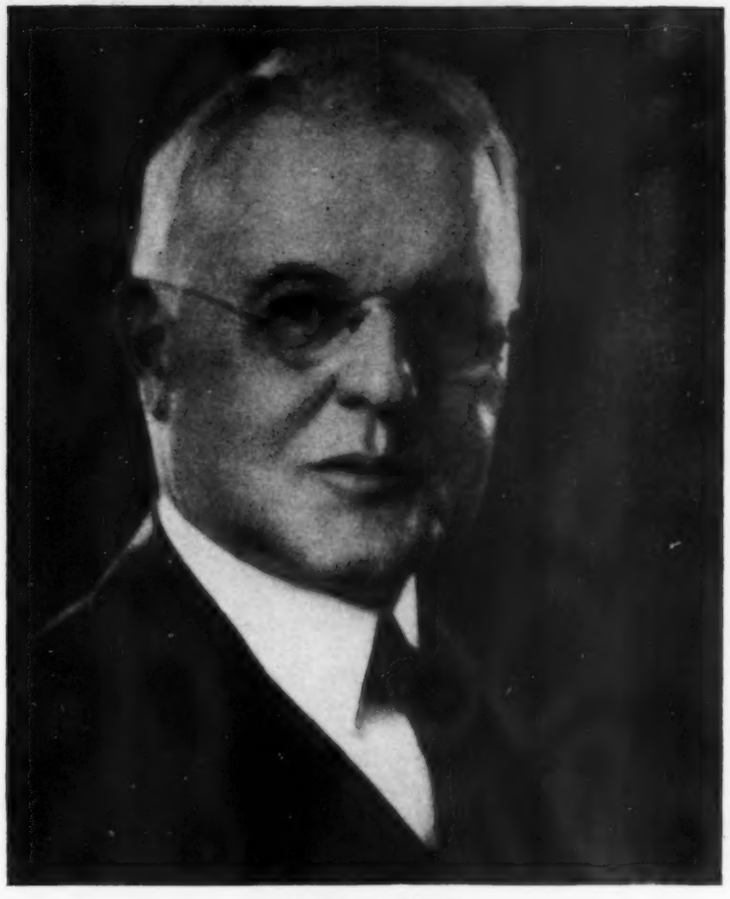
Nature of the war to date has made leisurely preparations and protracted bargaining between the government and industry possible. With the exception of airplanes and ships, there has been no haste necessary in war equipment because of the small destruction as yet and because British planes are continuing to produce at a speed which piles up reserves of war materials.

It will cost about $5,000 per boat to refit Lake boats for the extra strain of ocean travel. This may be done and the Canadian boats transferred to ocean ports before the annual freeze-up so that they will be available for transport of goods in case they should be needed. These boats are particularly adapted to coastal traffic; for example, they could be used between the West Indies and Canada, thus releasing ships now engaged in this service for trans-oceanic freight movement.

In the last war Britain didn't start important purchases in Canada until the latter stages, and then the need was so urgent that contracts were awarded with little attention to terms so long as speed was secured. The result was that profits skyrocketed for many companies and a tremendous wave of plant expansion set in.

During the current war it is believed that the program is being carried out so that this runaway spirit will not be in evidence.

AWARDED MEDAL BY A.S.M.E.



JAMES E. GLEASON

Gleason Receives 1939 A.S.M.E. Medal; Johannson and Eksergian Also Honored

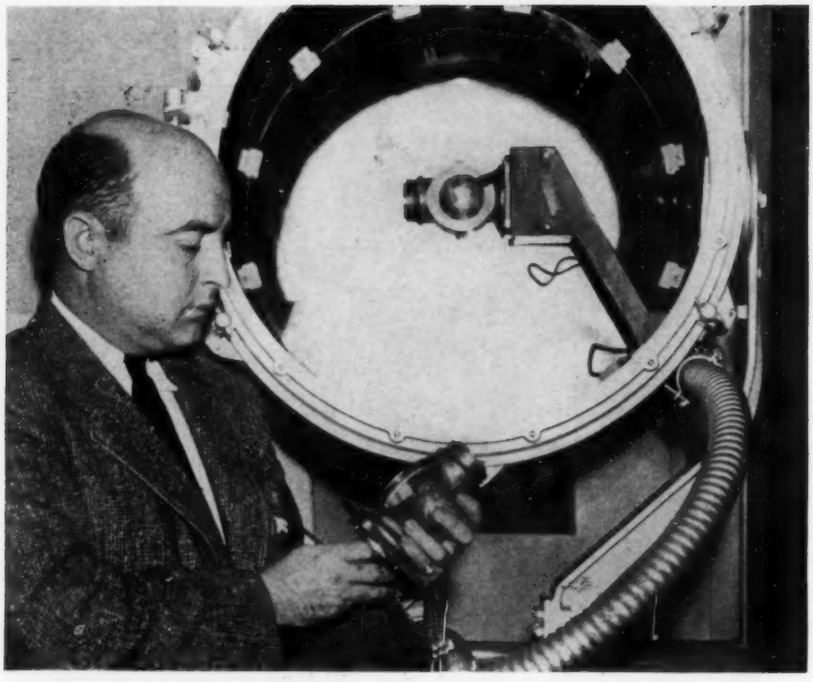
DR. RUPEN EKSERGIAN

NEW YORK—James E. Gleason, president of the Gleason Works, Rochester, N. Y., has been awarded the 1939 A.S.M.E. Medal, "for service to the cause of safer and better transportation." Mr. Gleason will be presented with the medal at the 60th annual meeting of the American Society of Mechanical Engineers to be held in Philadelphia Dec. 4-8.

Carl Edvard Johannson, of Eskilstuna, Sweden, is the recipient of the society's Holley Medal, "in recognition of his pioneer work in the development of basis measuring gages," used throughout the world by the metal-working industry.

Dr. Rupen Eksergian, of the Edward G. Budd Mfg. Company, Philadelphia, has been awarded the Worcester Reed Warner Medal "for influential engineering papers of permanent value published in the transactions of the A.S.M.E."

The Pi Tau Sigma Medal will go to John I. Yellott, assistant professor of Stevens Institute of Technology, with the citation "outstanding mechanical engineer of 1939." The Charles T. Main Award of $150 will be presented to James R. Bright, Swampscott, Mass., for his paper on the economics of investment in new manufacturing equipment.



Brilliant—*A beam of more than 25,000,000 candlepower is thrown by this searchlight developed by General Electric. Three tiny water-cooled mercury lamps, rated at 1,000 watts each, produce the light. Self-contained cooling system makes the unit suitable for use in locations not easily accessible*

NATURAL RECOVERY ACCOUNTS FOR UPTURN, SAYS E. G. GRACE

NEW YORK—Natural recovery is the chief cause of the business upturn, according to Eugene G. Grace, president Bethlehem Steel Corp., in a letter addressed to employees. Bethlehem today has better employment conditions than ever before. It has more than 100,000 employees, who have average earnings per day of $7.03.

"It is gratifying that our products are going largely into consumption and not into inflated inventories," said Mr. Grace. "The present buying movement does not represent important demand from the warring countries. We must, however, always serve our own government for the materials it must have for national defense. We want peace and the kind of business that goes with peace."

CANADIAN FIRMS EXPAND

TORONTO—Plant expansions in Canada are increasing as war needs become larger. L. A. Young Industries of Canada, Toronto, will erect a one-story factory at Leaside, Ont. Canadian Hanson & Van Winkle Co., Ltd., Toronto, has awarded a contract for a factory addition. Toronto Iron Works & Steel Co. of Canada, Ltd., Hamilton, have plans for additions.

BUSINESS ITEMS

Allegheny Ludlum Steel Corp., Pittsburgh, Pa., has appointed the J. M. Tull Metal & Supply Co., Atlanta, Ga., as its Georgia tool steel representative.

Chain Belt Co., Milwaukee, Wis., held its first open house Nov. 4 with members of its Quarter Century Club acting as hosts.

Cleveland Punch & Shear Works Co., Cleveland, Ohio, has awarded contract to the Austin Co. for design and construction of a 34,000-sq.ft. addition to its plant. The project will represent an investment of some $250,000 for new plant and equipment.

Coppus Engineering Corp., Worcester, Mass., has appointed the following district representatives: Rees V. Downs, Memphis, Tenn.; Hughes Machinery Co., Kansas City, Mo.; and L. D. McKay, Tulsa, Okla.

Eclipse Moulded Products Co., Milwaukee, Wis., has begun a $60,000 plant expansion program.

Copperweld Steel Co., Warren, Ohio, has purchased the plant and assets formerly owned by the American Puddled Iron Co. at Warren. On the 423-acre property will be erected a $2,000,000 steel plant, including equipment capable of producing 100,000 tons of alloy steel annually. Present buildings will furnish a nucleus for the new plant which, when completed, will spread over 285,000 sq.ft. of floor space.

Fox Engineering Co., Jackson, Mich., has been incorporated to succeed the Fox Machine Co., which has been liquidated. New organization has acquired all patents, engineering data and sales records of Fox Machine and plans to continue designing and building the same type of drilling machines and presses as built by the former company.

V. L. Graf Co., Detroit, Mich., which began two years ago as a two-man shop, has moved into its own 2,000-sq.ft. modern plant at 9456 Grinnell Ave. Facilities are available to manufacture an extensive line of steel hydraulic tube fittings, hose couplings and hydraulic accessories.

The Hoist & Body Div. of Gar Wood Industries, Inc., Detroit, Mich., has appointed the following distributors: Robert P. Stapp, Birmingham, Ala.; Lundberg Equipment Co., Logan, Utah; Cate Equipment Co., Salt Lake City, Utah; and Wilson Equipment & Supply Co., Cheyenne, Wyo.

Holo-Krome Screw Corp. is building an addition of approximately 8,500 sq.ft. to its present plant in Hartford, Conn.

Kelly Reamer Co. has appointed James S. Murray, Pittsburgh, Pa., for the exclusive sale of Kelly products in the Pittsburgh territory.

Mechanical Handling Systems, Inc., Detroit, Mich., has appointed Wonham, Inc., New York, N. Y.; and Kearney Engineering Co., Philadelphia, Pa., as representatives.

William Morse, senior president of the Morse Tool Co., Detroit, Mich., is offering his entire plant for sale as a unit and will retire.

Philippine Commercial Co., 347 Fifth Ave., New York, N. Y., desires to represent, in the Philippines, American manufacturers of tools and hardware.

Progressive Welder Co., Detroit, has contracted with the Austin Co., Cleveland, for construction of a modernistic plant at 3050 E. Outer Drive. Building will measure 150x180 ft., and aisles and entrance ways will be large enough for trucks to drive into the 60x150-ft. crane bay for unloading. A large demonstration room will be completely equipped so that customers can test performance of their purchases. Much equipment has already been bought for the new enterprise, but additional items are still to be placed.

OWEN D. YOUNG

GERARD SWOPE

PHILIP D. REED

CHARLES E. WILSON

Swope, Young Resign G.E. Positions; Places to Be Taken by Wilson and Reed

GERARD SWOPE, president of the General Electric Co., and OWEN D. YOUNG, chairman of the board, have resigned these positions as of Jan. 1, they revealed in a letter to the board of directors, meeting in New York City Nov. 17. Mr. Swope and Mr. Young will become honorary president and honorary chairman. Their positions will be assumed, respectively, by CHARLES E. WILSON, executive vice-president, and PHILIP D. REED, assistant to the president.

". . . When we took office [in 1922] we indicated our view that it would contribute to the morale and effectiveness of the organization if as a general rule men in important administrative positions would consider retirement when they reached the age of 65 . . .," reads the letter signed jointly by Messrs. Swope and Young. "Having adopted that policy of retirement during our administration, we apply it to ourselves . . . with no reservation because there are younger men . . . now available for these offices . . . We will remain as directors and make ourselves available for such service as you and your successors may deem helpful . . ."

Born in St. Louis, Mo., in 1872, Mr. Swope got his first job as a helper in G. E.'s Chicago service shop while still an undergraduate at Massachusetts Institute of Technology. He received the degree of electrical engineering in 1895 and returned to Chicago, this time in the shops of the Western Electric Co. After working his way up from there to a directorship and vice-presidency, Mr. Swope was brought back to G.E. by the late CHARLES A. COFFIN. When the company's foreign department was enlarged into the International General Electric Co. in 1919, Mr. Swope became its first president.

Owen D. Young was born in Van Hornesville, N. Y., in 1874. Having decided upon law as a career, he entered Boston University, completing the three-year course in two years. His law work brought him in close contact with the newly formed electrical engineering firm of Stone & Webster. In this way he gained knowledge of the electrical development which attracted the attention of Mr. Coffin, then president of G.E. In 1913 Mr. Young was appointed to succeed the late HINSDILL PARSONS, general counsel for the company. When Mr. Coffin resigned in 1922, Mr. Young was chosen as chairman of the board to succeed him.

Charles E. Wilson has been executive vice-president of G.E. since 1937. He was born in New York City in 1886, and in 1899 began as an office boy with Sprague Electric. He went from office boy to shipping clerk, factory accountant, production manager, and then assistant superintendent of the factory in 1914. Shortly after that he was appointed sales manager. In 1918, the year following transfer of the conduit business from Sprague to G.E., he became assistant superintendent of the Mazpeth, L. I., and New Kensington, Pa., works. In 1925 he was appointed assistant manager of G.E.'s Bridgeport works. In 1928 he became assistant to the vice-president in charge of the merchandise department, becoming vice-president in charge of that department two years later.

Philip D. Reed, since 1937 assistant to the president, was born in Milwaukee, Wis., in 1899. He entered General Electric in 1926 as assistant to vice-president C. W. APPLETON of the company's law department in New York. In 1928 he was transferred to the incandescent lamp department; and from 1934 until his appointment assistant to the president in 1937 was general counsel for the lamp department.

PERSONALS

JAMES L. ASHLEY, secretary and treasurer International Nickel Co. of Canada, Ltd., has retired. He is succeeded by WILLIAM J. HUTCHINSON, who succeeds Mr. Ashley as treasurer and was also elected a director.

L. T. BLAISDELL, since 1936 commercial vice-president of the General Electric Co. with headquarters in Dallas, Texas, has been named manager of the East Central district, succeeding the late W. J. HANLEY. W. B. CLAYTON will replace Mr. Blaisdell in Dallas as manager of the Southwestern district.

WILLIAM B. CREIDER, for the past seventeen years associated with the Oilgear Co., Milwaukee, Wis., has resigned.

GANO DUNN, president of J. G. White Engineering Corp. and of Cooper Union, has been chosen as the 1939 recipient of the Hoover Medal, "awarded by engineers to a fellow engineer for distinguished public service," it has been announced by JOHN V. W. REYNDERS, chairman of a board of award representing the four national societies of civil, mining and metallurgical, mechanical and electrical engineers.

F. A. FARON, manager of the New Haven office, and E. G. DUDLEY, manager of the New York district industrial department, General Electric Co., Schenectady, N. Y., have been named assistant managers of the industrial department of the New York district.

CLAYTON P. INNES has been appointed Omaha representative of Cutler-Hammer, Inc., Milwaukee, Wis.

RALPH HUBBART, former vice-president Allied Products Co., Detroit, Mich., has been elected president, succeeding the late CLEMENT C. RICH-

ARD. W. E. RAY is now vice-president and secretary, having been secretary and treasurer. J. F. HALM is treasurer and assistant secretary.

FREDERICK J. GRIFFITHS, for the past three years president of the Griffiths-Bowman Engineering Co., has been elected vice-president in charge of the newly created Alloy Steel division of the Copperweld Steel Co. at Warren, Ohio.

From 1913 to 1926 Mr. Griffiths was with the Central Steel Co., in positions ranging from general superintendent to president and general manager. For the next three years he was chairman of the board of the Central Alloy Steel Corp. From 1929 to 1931 he was president of Republic Research Corp., and a member of the board of Republic Steel Corp. Subsequently he was president of the Timken Steel and Tube Co., and a member of the board of the Timken Roller Bearing Co.

HARRY E. KELLOGG has been named treasurer of the Link-Belt Co., Chicago, Ill., succeeding RICHARD W. YERKES, who has retired after 50 years of service.

MAURICE K. MCGRATH has been elected president of the Kellogg Switchboard & Supply Co., Chicago, Ill., succeeding J. G. KELLOGG.

JOHN M. NICHOLSON, former New York zone engineer of the Pennsylvania & Long Island Railroad, has been named assistant to the chief engineer.

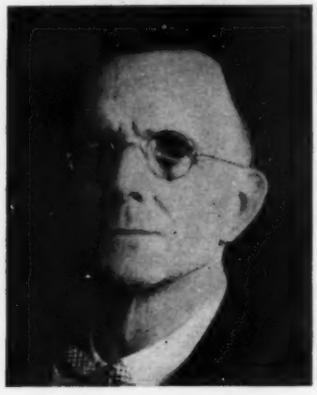
C. E. H. PALMER, former manager of the Newark, N. J., office of the General Electric Co., Schenectady, N. Y., has been appointed manager of the organization's New Haven, Conn., office.

O. SMALLEY, president Meehanite Metal Corp., Pittsburgh, Pa., has been reelected president of the Meehanite Research Institute of America, Inc. Also reelected were H. B. HANLEY, foundry manager American Laundry Machinery Co., Rochester, N. Y., vice-president; F. M. ROBBINS, president Ross-Meehan Foundries, Chattanooga, Tenn., secretary-treasurer.

HAROLD J. STEIN has been named to the newly created post of director of research, chemistry and metallurgy for manufacturing developments of the Allis-Chalmers Mfg. Co., West Allis, Wis. J. T. JARMAN will serve as his assistant.

P. Y. TUMY, formerly in charge of the Grand Rapids office of the General Electric Co., has been selected to succeed A. L. POND as manager of the Milwaukee office. Mr. Pond is retiring after 25 years as manager of that office.

OBITUARIES



CLARENCE W. SPICER

CLARENCE W. SPICER, vice-president Spicer Mfg. Corp., Toledo, Ohio, manufacturer of universal joints, died Nov. 21 in Miami, Fla. He was 63 years of age.

Born in West Hallock, Ill., Mr. Spicer attended Alfred and Cornell universities. In 1902 he founded the Automotive Parts Corp., soon after he had invented the Spicer universal joint. From 1910 to 1914 he headed the Spicer Mfg. Co. of Plainfield, N. J., and for the following year was president of Spicer Mfg. Corp. He became vice-president of this organization in 1915. In 1930 the corporation was moved to Toledo.

Mr. Spicer had also been president of the Society of Automotive Engineers and had served as chairman of the A.S.M.E. Committee on Standardizing Small Tools and Machine Tool Elements.

FRANCIS P. ABERCROMBIE, 87, a retired superintendent of the New York division of the Pennsylvania Railroad, died Nov. 11 at his home in Chestnut Hill, Pa.

MRS. HARRIET F. ANDREW, 72, owner of the Fisher & Norris Anvil Works, Trenton, N. J., and said to be the only woman in the United States actively engaged in the iron working industry and the first woman member in the National Association of Manufacturers, died Nov. 16.

MATTHIAS F. CUNNINGHAM, president Waltham Grinding Wheel Co., Waltham, Mass., died Nov. 6 of a heart attack, at his home in that city.

W. J. HANLEY, for 51 years associated with the General Electric Co., and for the past ten years commercial vice-president with headquarters in Cleveland, died Nov. 9 in that city. He was 72 years of age.

Mr. Hanley began his service in 1888 with the old Thomson-Houston Co. in Ohio as a construction foreman. When General Electric was formed from the union of Thomson-Houston and Edison Electric, Mr. Hanley continued with the new company. In 1903 he became a member of the supply department of the Cincinnati office, two years later was appointed manager of the Columbus office, and in 1915 became manager of the company's East Central district.

CHARLES F. KRAUT, 58, former foreman at the Russell & Erwin Mfg. Co., New Britain, Conn., and a contributor of many articles on tool engineering to *American Machinist*, died Nov. 11 following a ten-months illness. He had also served for eight years as a mechanical engineer with the Segal Lock Co. of South Norwalk, Conn.

RALPH S. MACPHERRAN, 67, chief chemist of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., and an expert in gray iron metallurgy, died Nov. 13 in Duluth, Minn. He had been with the company for 40 years.

CHARLES W. PASCHE, 76, president Davenport-Besler Corp., Davenport, Iowa, locomotive manufacturer, died Nov. 15 of a heart ailment.

CLEMENT RUEGG, 59, chief diesel engineer Nordberg Mfg. Co., Milwaukee, Wis., and for the past 23 years associated with the firm, died Nov. 9.

MEETINGS

AMERICAN ENGINEERING COUNCIL. Annual meeting, Mayflower Hotel, Washington, D. C., Jan. 11–13.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Winter convention, New York, N. Y., Jan. 22–26.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Annual meeting, Blackstone Hotel, Chicago, Ill., Jan. 16–18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Sixtieth annual meeting, Bellevue-Stratford Hotel, Philadelphia, Pa., Dec. 4–8.

MOTOR & EQUIPMENT MANUFACTURERS ASSOCIATION. Annual meeting, Blackstone Hotel, Chicago, Ill., Dec. 12.

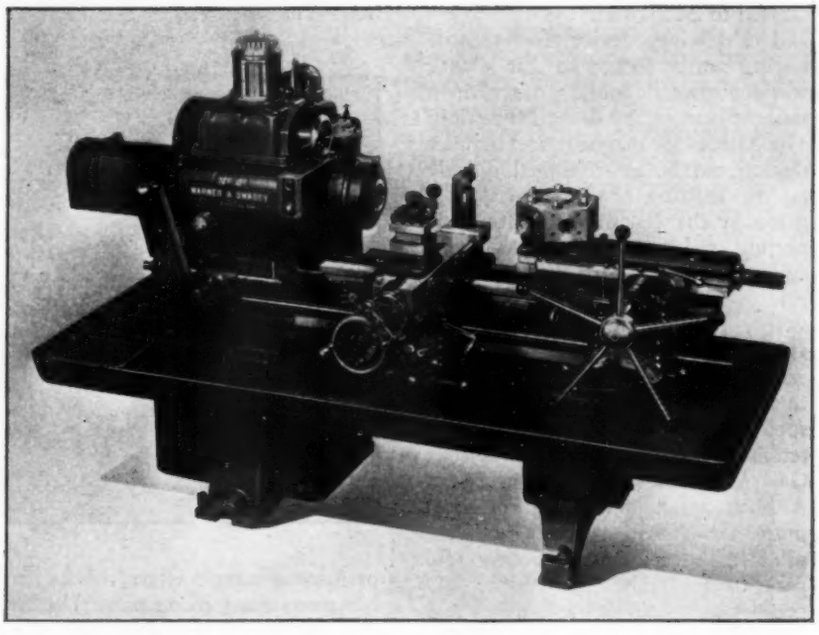
NATIONAL ASSOCIATION OF MANUFACTURERS. Annual meeting, Hotel Waldorf-Astoria, New York, N. Y., Dec. 7–9.

NATIONAL STANDARD PARTS ASSOCIATION. Annual meeting, Sherman Hotel, Chicago, Ill., Dec. 8–9. A.S.I. Show, Navy Pier, Chicago, Dec. 11–16.

SOCIETY OF AUTOMOTIVE ENGINEERS. Annual meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 15–19.

SHOP EQUIPMENT NEWS

Warner & Swasey No. 4 Ram-Type Turret Lathe Equipped with Pre-Selector Head and Brake



Originally to have been introduced at the Machine Tool Show, the improved No. 4 ram-type turret lathe offered by the Warner & Swasey Co., Cleveland, Ohio, has an improved bed design, a head brake and improved lubrication. It is available with the pre-selector head only. With this head, only one lever is required to shift the gears, instead of two, three or four, and cutting operations are placed on a surface-feet-per-minute basis which simplifies operation of the lathe. This lathe has a bar capacity of 2 in., which is $\frac{1}{4}$ in. larger than the No. 4 machine it replaces, and an $18\frac{1}{4}$-in. chucking swing.

A new bed design that features diagonal ribbing is said to increase the rigidity of the bed by almost 30 per cent, and so maintains accuracy during extreme cutting conditions. The bed construction also increases the clearance space for chips as they fall into the pan. Oil is stored in a reservoir in the base of the machine and the head is lubricated by a forced feed system. It is claimed that the lubricant is kept cooler by this arrangement. The spindle brake can be released after the spindle is stopped to allow positioning of chucks and fixtures.

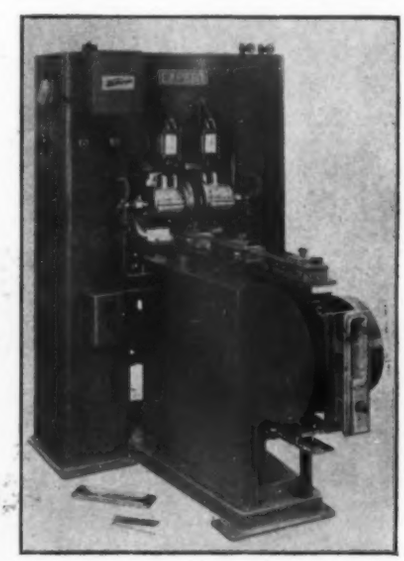
There are six reversible power feeds, both cross and longitudinal, for the universal cross slide. All feeds increase uniformly to provide a proper range for all classes of work. The square turret on the cross slide indexes automatically, and the cross slide dial has widely spaced graduations for accurately measuring the depth of cut. A plunger oil pump on the cross slide lubricates both the cross slide and bed bearings.

The hexagon turret is equipped with adjustable stops for automatically tripping the feed for each turret face, and the turret may be indexed or "spun" in either direction to skip tool stations. Adjustable taper gibs at the side and top of the turrret slide assure proper fit. The hexagon turret revolves on an adjustable tapered roller bearing center stud. Hardened replaceable plates under the slide "wear-proof" the unit. Motor and drive are completely inclosed in a cabinet leg directly under the head end of the machine. Multiple V-belt drive is standard.

Automatic Spot Welding Done with Seamwelder

Continuous automatic spot welding with a seamwelder has been made possible by the use of a standard Weltronic weldtimer which accurately controls length of time current is on and off, and provides an automatic repeating cycle. Designed and built by Expert Welding Machine Co., Detroit, Mich., the machine is able to make accurately spaced spots and to adjust the length of spots to the size desired, irrespective of production rate. Developed for series spot welding No. 19 gage oil baffle plates to No. 18 gage valve cover plates for six and eight cylinder cars, this welder includes a conveyor for carrying the work under the seam rolls, a 50 kva. transformer, timer and contactor.

The motor-driven conveyor carries ten short-circuiting dies on which are placed the valve cover plates. The baffle plate and cover plate are located



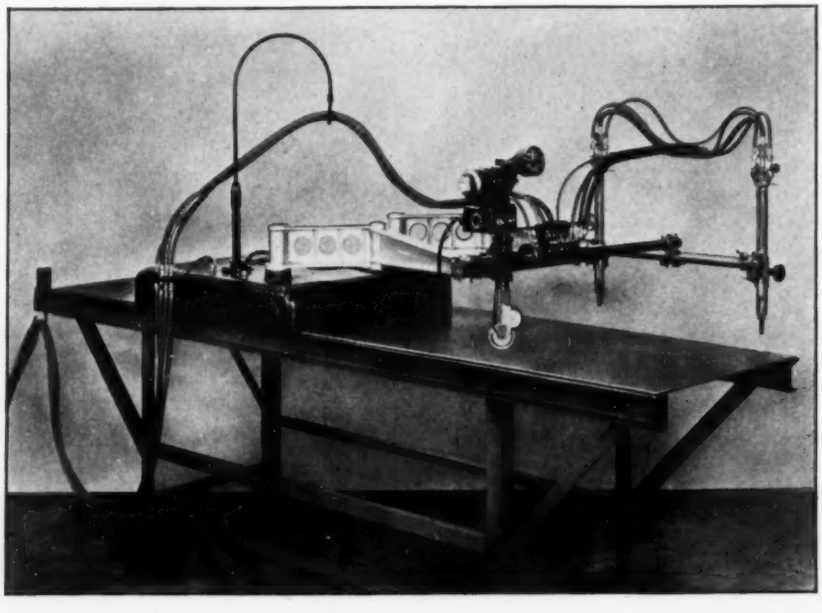
and held in position by means of a stud with a bayonet fitting. As the conveyor carries a loaded die under the rolls, a cam on the side of the die trips an air valve. This admits air into the pressure cylinders that bring the rolls into contact with the work. A limit switch then automatically starts the timer. When the last spot weld has been completed the cam on the side of the moving die releases the pressure switch, cutting out the timer and raising the rolls from the work. The timer, built by Weltronic Corp., 2832 E. Grand Blvd., Detroit, has dial controls.

Airco No. 10 Planograph Cutter Features Cam Control of Gases

Straight lines, rectangles, circles and irregular shapes can be cut rapidly from ferrous metal of any thickness within the present practical limits of the cutting torch by the "Airco" No. 10 Planograph announced by Air Reduction Sales Co., 60 E. 42nd St., New York, N. Y. Although a stationary-type machine, this unit can be moved by crane to different locations in the shop. It consists of a tracing table upon which the carriage travels. This carriage supports the torches and tracing devices. Including the work table, this machine requires a working area of only $5\frac{1}{2}$ x $10\frac{1}{2}$ ft.

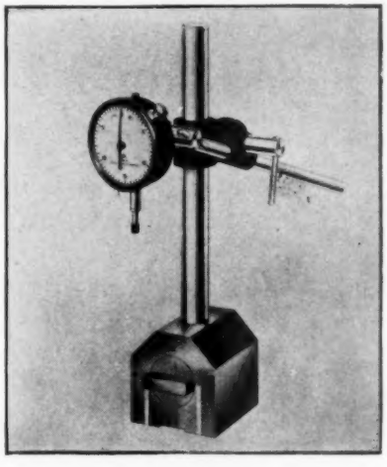
Cutting range with a single torch is 24 in. wide by 72 in. long. This length can be increased indefinitely in multiples of 72 in. by using additional tracing tables. Maximum diameter of circle cut is 24 in. When two torches are mounted on the regular operating bar for simultaneous cutting, the cutting area for each is 12 in. wide by 72 in. long. Two circles up to 12-in. diameter can be cut with the torches mounted in this manner. By using an auxiliary bar, the cutting area of each torch is increased to 24 x 24 in.

The tracing device for manual tracing can be locked so that it will, without manual guiding, travel in a straight line, in any desired direction. The devices for magnetic and templet tracing can be interchanged quickly on the existing head. Provision is made at the tracing head for connecting a lamp to light the work table. A switch for forward and reverse motion, and the magnet switch, also are conveniently located at this point. Speed of the motor is governed by a graduated disk known as the index speed control. Cutting speed in inches per minute is registered on the reversible tachometer. Gas control unit is centrally located. A knob handle operates cams, progressively arranged, one each for pilot light, acetylene (or other fuel gas), oxygen preheat and cutting oxygen. One complete cycle lights and cuts off in proper sequence. Handwheels mounted on either end of this unit permit control of the torch from either end of the tracing bar at the convenience of the operator.



B. & S. Dial Indicators Have Magnetic Bases

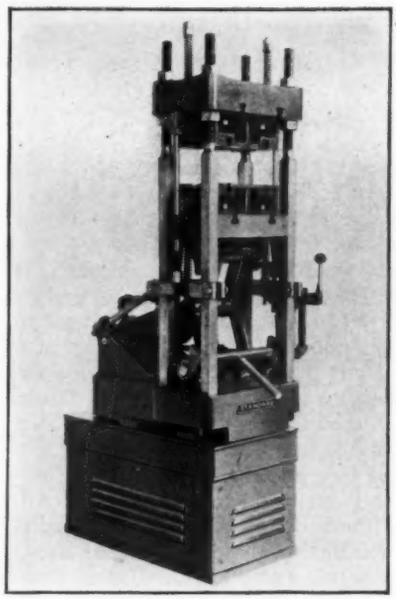
Two dial test indicators, listed as Nos. 744 and 744A and having magnetic bases, have been announced by Brown & Sharpe Mfg. Co., Providence, R. I. These dial test indicators permit settings that would not be possible without clamps when using other indicators. With a simple turn of the control to "on" the magnetic base will hold securely to any flat surface of iron or steel. The base is released by turning the control to the "off" position. The bases follow the design of



permanent-magnet type chucks and have only one moving part. The No. 744 unit can be furnished with either $\frac{3}{10}$- or $\frac{1}{2}$-in. spindle movement by half-thousandths of an inch. The No. 744A gage has jeweled bearings and a spindle movement of 0.020 in. by ten-thousandths of an inch. The magnetic base and upright can be obtained separately. These test indicators are offered for sale only in the United States and its territories.

Plastics Molding Press Has 20-ton Capacity

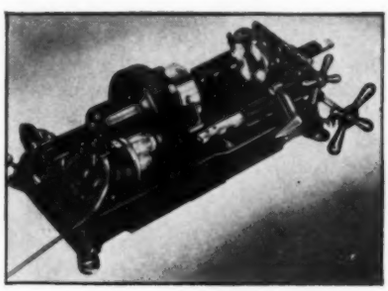
Two 20-ton capacity quick-acting, toggle-type molding presses for plastics have been developed by the Standard Machinery Co., Mystic, Conn. These presses are marketed by the F. G. Stokes Machine Co., 5930 Tabor Rd., Olney P.O., Philadelphia, Pa. They are similar in capacity, stroke, openings between platens, and other features. One is a self-contained, hydraulically-operated unit with motor and duplex pump in the base. The other is designed for air operation at 125 lb. per sq. in. pres-



sure, and is furnished without motor or pump ready to connect to the pressure supply. These 20-ton presses are recommended for experimental purposes, as well as for all production work within their range. Opening speed is 80 in. per min. and closing speed is 75 in. per min.

Beaver Pipe Unit Has 2-in. Capacity

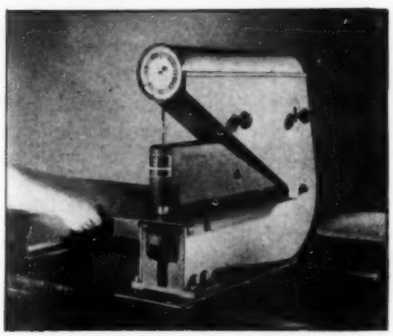
The improved Model B pipe cutting, threading and reaming machine offered by Beaver Pipe Tools, Inc., Warren, Ohio, has capacity for $\frac{1}{8}$ to 2 in. pipe and will thread both ranging from $\frac{1}{4}$ to 2 in. in diameter. Quick-opening adjustable ring-type die heads are used, as is a ball-bear-

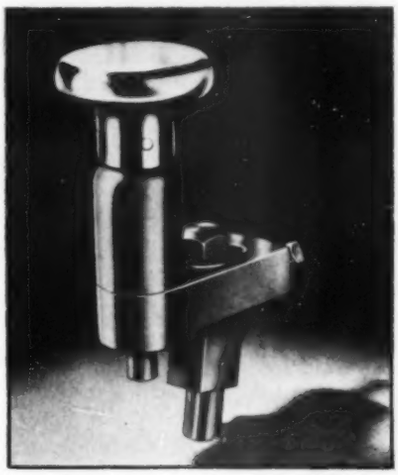


ing wheel-and-roller type cutoff tool. This machine is driven by a 110 or 220 volt universal motor of 1.6 hp. It is available with a gear-driven oil pump, with a one-gallon overhead reservoir which feeds by gravity, or it may be used with a hand oiler. It can be used on a bench, or fitted with legs. Weight is 250 lb., and the base measures 36x18 in.

"Guyer" Micrometer Checks Sheet Thickness

A mechanical micrometer designed to provide a means for rapidly and accurately checking the thickness or gage of metal sheets, the "Guyer Gager" offered by Streeter-Amet Co., 4101 Ravenswood Ave., Chicago, Ill., has an automatic measuring cycle. In operation, the device clamps a sheet at any point the thickness is to be measured. The work is held at this point long enough for the operator to read the large dial. It then is automatically released for removal from the machine, or to the next point to be measured. The cycle of clamping, gaging and releasing is repeated constantly. Cycle frequency is under the control of the operator. The standard machine will indicate from 8 to 38 gage readings per minute. Throat of the machine is 23 in. deep to permit exploring wide sheets. The dial is graduated in 0.001 in. increments so that any desired tolerance may be established by means of adjustable dial rim markers.





Screw Machine Feed Handle Keeps Gears in Mesh

Modern Collet & Machine Co., 401 Salliotte St., Ecorse, Mich., has introduced a feed handle for use on Gridley automatic screw machines to keep gears in mesh. Handle is so adjusted that in the meshing of the gears and feed box these gears will positively stay meshed, eliminating all rattle and unnecessary wear on the feed box gears as well as on the feed box speed change holes.

Reed-Prentice Vertical Keyseater Can Be Used As Vertical Miller

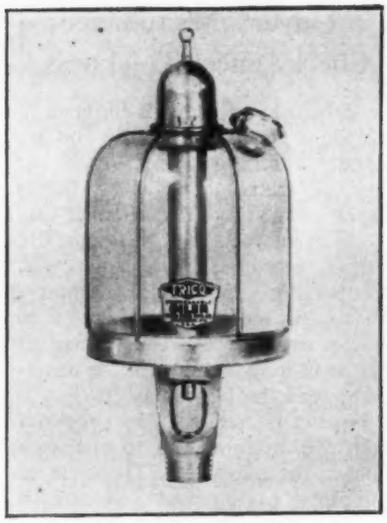
Designed for machining keyways, slots, splines and recesses, this keyseating machine offered by Reed-Prentice Corp., Worcester, Mass., also can be used as a light-type, hand-feed vertical milling machine. The high range of spindle speeds makes this machine suitable for general toolroom work. When cutting keyways or slots, the spindle head is reciprocated by an adjustable crank motion which has a compensating device providing constant speed of slide in both directions. A lock is provided for the spindle head when the machine is to be used for milling operations.

Spindle unit is in the form of a sleeve, with the spindle mounted in dual ball bearings. Spindle nose has a split-collet type chuck. Hand feed and five rates of automatic down feed are provided for the spindle sleeve. Feeds are independent of the recipro-

cating travel of the spindle head. A depth scale which operates in conjunction with a trip is provided. A two-speed vertically mounted flange-type motor provides two drives by means of V-belts. One drive gives a choice of six speeds to the cutter spindle, and the other drive provides a choice of four rates of reciprocating travel to the spindle head for each spindle speed.

The entire drive is inclosed by a hinged cover which permits easy access for speed changing. Cover is interlocked electrically so that belts cannot be changed while in motion. Table, saddle and knee are made in accordance with conventional milling machine practice and are provided with hand feed in all directions. The column is a one-piece casting, the base forming a coolant sump. A gear pump is mounted inside the machine column, and is driven by belt from an extension of the feed reduction box.

Specifications: Maximum keyway cut with automatic crank drive, $\frac{3}{4}$ x 5 in.; maximum keyway cut, using table adjustment, $\frac{3}{4}$ x 20 in.; maximum keyway cut, $2\frac{3}{4}$ in.; maximum distance from center of spindle to column, 10 in.; distance between spindle nose and surface of table, 12 in.; working surface of table, 26 x 9 in.; table movement, 15 in. longitudinal, $6\frac{1}{4}$ in. transverse and 12 in. vertical; range of spindle speeds, 290–2,350 r.p.m.; motor required 8 hp.; floor space, 4 x 5 ft.; net weight, 1,500 lb.



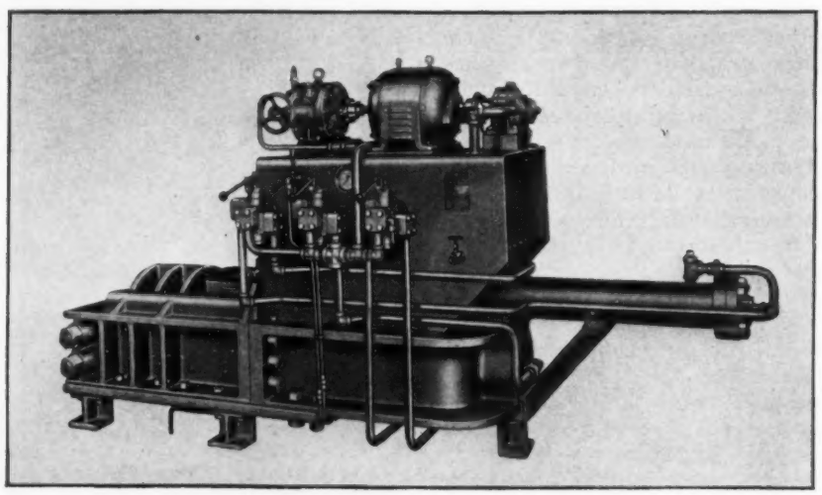
Gravity Feed Oiler Has Unbreakable Bottle

A line of visible gravity feed oilers in which the unbreakable bottle reservoir is cemented and roll-clinched to the heavy brass base, has been announced by the Trico Fuse Mfg. Co., Milwaukee, Wis. The oiler is mounted at the top of the part to be lubricated and any pre-determined number of drops of oil per minute can be obtained by simple adjustment of the ratchet control. After the desired adjustment has been made, no further attention is required except to keep a reserve supply of oil in the bottle.

H-P-M Baling Press Operates Hydraulically

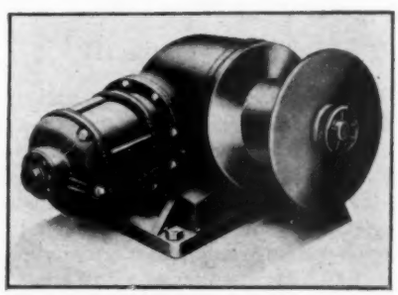
The H-P-M scrap metal baling press built by The Hydraulic Press Mfg. Co., Mt. Gilead, Ohio, consists of a box which is built up of heavy ribbed castings securely locked together. The box is closed by an hydraulically-operated lid which slides in ways in the box. Inside the box are two horizontal-acting hydraulically-operated platens, one traversing from the end and the other from the side of the box toward a forward corner. The sliding lid, platens and inner walls of the box are surfaced with removable steel wearing plates.

After the box has been filled with trimmings, punchings or similar scrap metal, the sliding lid is closed and the preliminary pressing platen moves toward the end of the box. When this platen has reached the end of its travel, the side baling platen moves forward, compressing the scrap into the finished bale. The sliding lid then is opened, returning the first platen with it. The side platen also is returned to its starting position. The finished bale then is ejected from the box by a pneumatically-operated ejector located underneath the box. All of the hydraulic actions are manually controlled by three piston-type valves. The pneumatic ejector also is controlled manually.



No. 14 Car Puller Handles 6 Loaded Cars

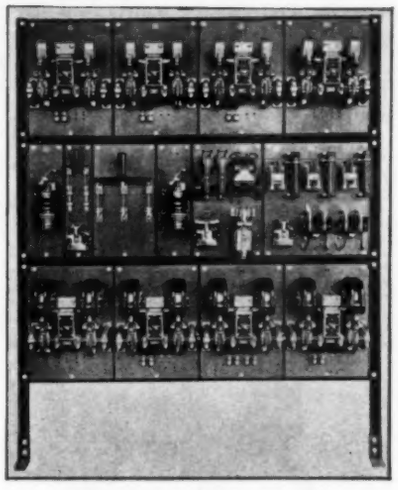
The No. 14 wire rope car puller offered by Stephens-Adamson Mfg. Co., Aurora, Ill., has a horizontal capstan, and has capacity for up to



six fully loaded cars. The drum will accommodate up to about 500 ft. of $\frac{5}{8}$ in. rope. One end of the pulling rope is fastened to the drum, which winds and stores surplus rope as the cars are pulled forward. Capstan speed is 13 r.p.m. and the unit is driven with a 10 hp. motor.

Dynamic Hoist Control Boosts Crane Performance

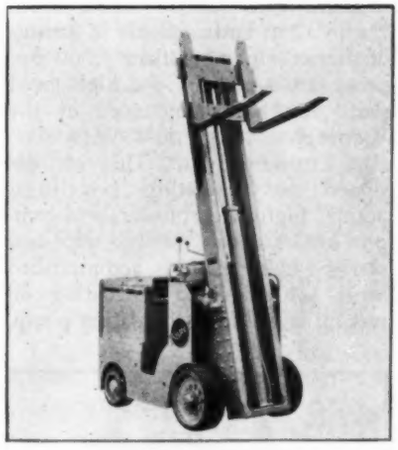
The dynamic lowering hoist controller for a.c. cranes developed by the Electric Controller & Mfg. Co., 2700 East 79th St., Cleveland, Ohio, is said greatly to increase crane performance by providing dynamic braking when lowering the load. It is operated entirely from alternating current power, no direct current is used. Perform-



ance is increased still further through faster lowering speeds. This system of crane control is said to be easy to operate, since hoisting and lowering motions are obtained by normal operation of the master switch.

Baker Fork Trucks Feature Center Control

The Series F, Type JOM center-control fork trucks offered by the Baker-Raulang Co., 2168 W. 25th St., Cleveland, Ohio, are available with capacities ranging from 2,000 to 7,000 lb. They are offered in tilting or non-tilting, telescoping or



non-telescoping models as required. The lifting system of these trucks operates hydraulically. It comprises a gear pump driven by a standard motor, a release valve, and a jack cylinder. The control is so arranged that putting the control handle into the lifting system opens the valve and starts the pump motor. Putting the control into the lowering position opens the valve and permits the fluid from the jack cylinder to return to the reservoir. Speed of lowering is entirely within the control of the operator.

"Phill-Co" Degreasers Electrically Operated

Three portable, electrically-operated degreasers have been made available by Phillips Mfg. Co., 348 W. Huron St., Chicago, Ill. These "Phill-Co" degreasers are easily moved about the plant and are made ready for operation simply by plugging the cable into electrical outlets. The Model 220-5 unit shown in Fig. 1 has 1½ gal. solvent capacity and operates on 220 volts, 60 cycle, alternating current. Fig. 2 shows the interior construction of the Model 220-9 degreaser, which has a 4 gal. solvent capacity. Size of the tank on this degreaser is 36 x 30 x 33 in. The third model has the same specifications as Model 220-5, but operates on 110 volt circuits. These units are built to use "Phillsolv", a non-inflammable fluid.

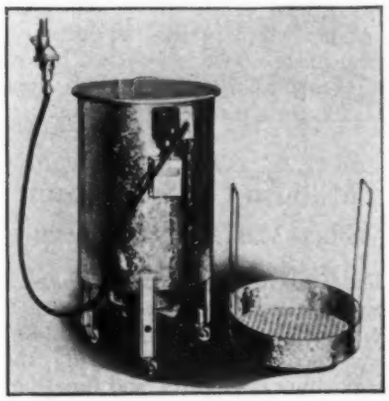


Fig. 1—Model 220-5 degreaser has a round tank and weighs 85 lb.

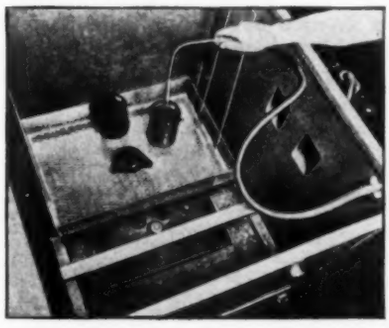
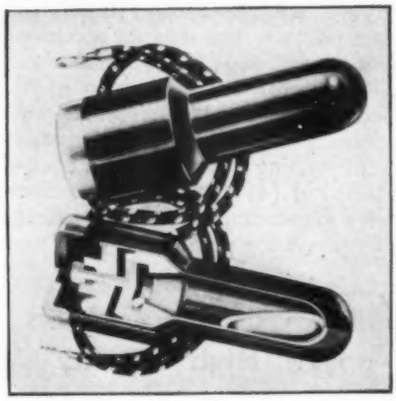


Fig. 2—Parts are placed in baskets for degreasing in the "Phill-Co" units. A hose is used to pressure-clean dirty parts

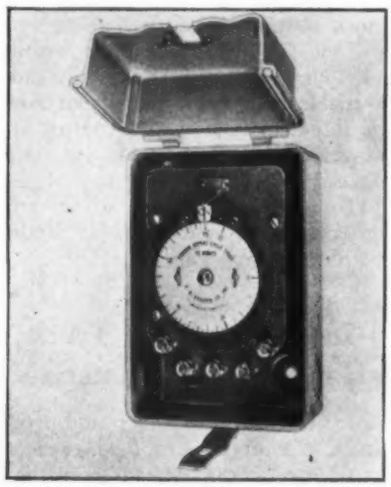


Improved Mercury Switch Offered by Durakool

Incorporating two reducing agents to prevent deterioration of the mercury, the improved "Durakool" metal mercury switch offered by Durakool, Inc., Elkhart, Ind., has been made to withstand severe service. It is silent, non-inflammable, and available in capacities up to 200 amp., and larger on special order.

Cramer Cycle Timer Used on A.C. Circuits

Designed for use on a.c. circuits, the repeat cycle timer offered by the R. W. Cramer Co. Inc., Centerbrook, Conn. will (1) alternately close and



open one or two circuits continuously at any preset operating interval, or (2) close or open a single circuit after any preset operating interval and stop, ready to repeat its cycle of operation upon reclosure of a starting switch. Among the features claimed for this timer are: (1) a variety of time ranges, (2) should any inter-

ruption to service occur the timer does not reset, but resumes operation where it left off, (3) the synchronous timing motor will start within ± 20 per cent of rated voltage and will stay in synchronism beyond a satisfactory operating voltage for other equipment, and (4) the switch mechanism has a snap-action with positive lock in both operating positions.

Improved Spray Cleaners Have High Capacity

Available as stationary or portable units, the Model J-H and Model J-R heavy-duty, "Hypressure Jenny" spray

cleaners announced by Homestead Valve Mfg. Co., Inc., Coraopolis, Pa., have electric spark ignition for quick starting. Pressures up to 150 lb. per sq. in. are obtained within 1½ min. Both of these units are available with continuous vapor flow or full automatic nozzle control arrangements. Either one or two nozzles can be used on the Model J-H super-capacity unit, while only one nozzle can be used on the Model J-R unit shown.

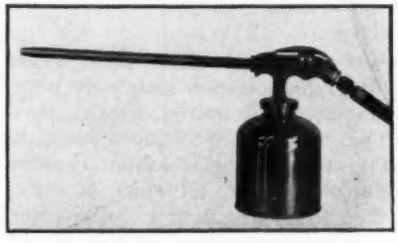
Industrial Scoop Truck Handles Loose Materials

Consisting of a power industrial truck, a scoop of ½ to 1 yd. capacity capable of being rotated more than 100 deg., and a power mechanism for elevating and lowering the load, this power scoop truck announced by the Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland, Ohio, has a separate motor for driving the scooping mechanism. Power plant optionally is electric or gas-electric, and operating power is furnished through three separate stand-

ardized motors. All motors are provided with slip clutches and limit switches which protect the operating mechanism. Dynamic electric brakes supplement the mechanical foot brakes for operation on ramps.

Milburn Oil Spray Gun Has Variable Delivery

The Type KSC oil spray gun offered by the Alexander Milburn Co., 1416 W. Baltimore St., Baltimore, Md., has been developed especially for removing caked grease and dirt from engines, springs, shackles and other

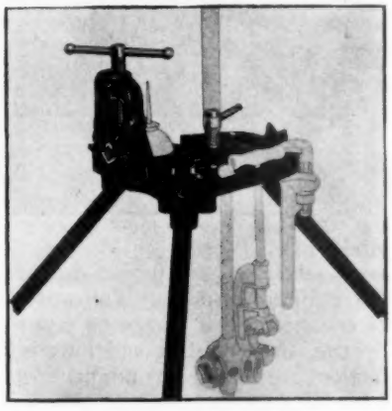


parts. It is equipped with a long nozzle, which is of particular advantage in reaching ordinarily inaccessible places. The gun uses kerosene, other cleaning solvents, or lubricating oils. Air enters the gun through the handle and siphons the fluid from the cup. Delivery is controlled by simply adjusting the fluted nozzle, a knurled nut locks it in operating position. Any desired volume may be obtained, from an almost solid stream to a finely atomized spray. For dusting and drying purposes, the fluid is shut off entirely.

Balance and Rigidity Features of Vise Stand

The Ridge Tool Company, Elyria, Ohio, has added to its "Rigid" line of pipe tools a vise with a three-legged stand of balanced construction designed to prevent tipping. The legs, hinged at the tray, fold together and fasten with a chain for convenient handling and carrying. They can be screwed to the floor if desired.

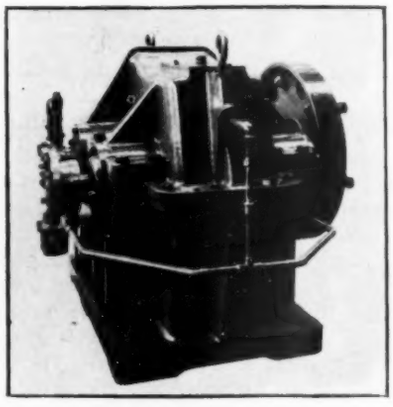
The tray is wide, providing space for oil cans and tools. The latter can be hung on the raised rim as well as in slots in the tray. There is a pipe



rest and three different size pipe benders that won't collapse the pipe. The "Tri-Stand" vises are available in 2½-in. and 4-in. chain patterns. Yoke vises have No-Mar jaws that protect pipe surfaces.

Speed Increasers Have Wide Operating Ranges

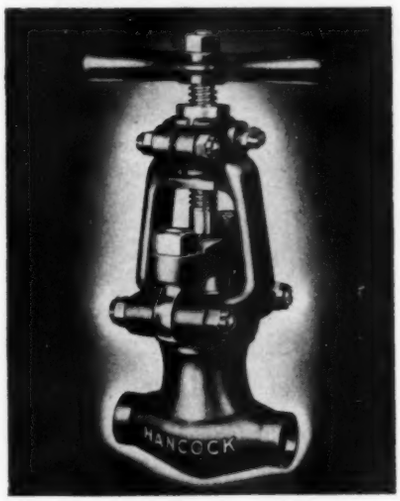
A line of speed increasers with standard gear ratios varying from 2:1 to 12:1, and available in ratings of from 1 to more than 1,800 hp. per 1,000 r.p.m. of the high-speed shaft, has been announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. They are designed for operating centrifugal pumps, high-speed blowers and compressors, as well as for pipe-line service. Lubrication is accomplished by a self-contained circulating oil system, including a circulating pump,



an oil cooler, strainer, relief valve, and sight flow indicator. Average efficiency of these units is said to be better than 96 per cent.

Improved Hancock Valve Has No-Bonnet Joint

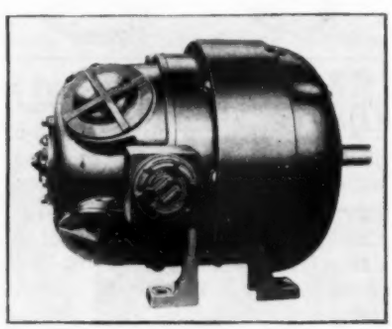
The Hancock Valve Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has developed the "No-Bonnet-Joint" valve to eliminate leakage through the gasket joint between the valve body and bonnet at elevated pressures and temperature. These valves are made for pressures up to

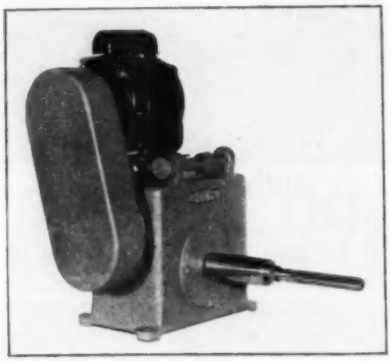


2,500 lb., at 1,000 F. When one of these valves is welded in the line, the only joint is that of the stuffing box for the stem. The valves are made in one basic size and then tapped, or bored for welding, for ½, ¾, and 1 in. pipe.

Reliance D.C. Motors Explosion-Proof

The Reliance Electric & Engineering Co., 1042-1090 Ivanhoe Rd., Cleveland, Ohio, now is building explosion-proof d.c. motors as large as 75 hp. Recent changes in the original design now make it possible to provide a complete range of sizes from 1 to 75 hp., all tested and approved by the Underwriters' Laboratories, Inc., for Class I Group D, hazardous locations.



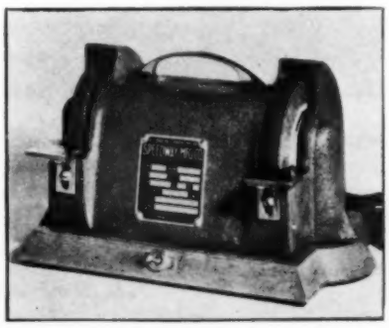


Catskill Power Reamer Mounts on a Bench

Equipped with a ⅓ hp. motor, this power reaming unit offered by Catskill Metal Works, Inc., Catskill, N. Y., can be mounted on a work bench or wherever convenient. Shipping weight is 100 lb. Speed control is accomplished by a three-step V-belt drive, the transmission being arranged to provide output speeds of 95, 120 and 165 r.p.m. The spindle has a No. 3 Morse taper, reducible with sleeves.

Speedway Bench Grinder Weighs Only 8¾ lb.

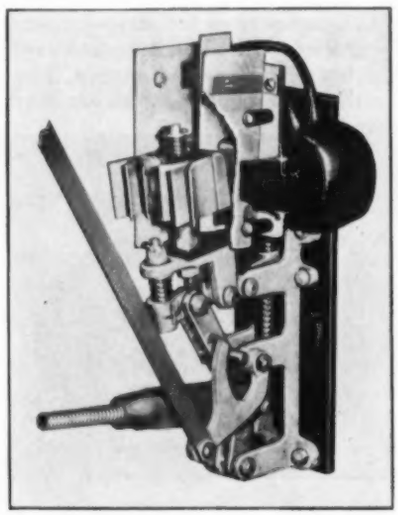
The Speedway Mfg. Co., 1834 S. 52nd Ave., Cicero, Ill., has developed the portable No. 119 bench grinder for tool and miscellaneous grinding.



Weighing only 8¾ lb., this grinder is 6½ in. high and the base measures 10½ x 6½ in. The 4⅜ x ⅜ in. grinding wheels are fully guarded, and the grinder rests on four rubber feet.

Pier Knee-Action Switch Controls Spot Welders

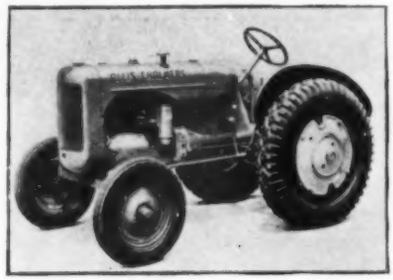
The Pier Equipment Mfg. Co., 801 Cross St., Benton Harbor, Mich., has announced the development of a "knee-action" toggle linkage type contactor or trip switch which supersedes the usual dog or ratchet mechanism for spot welder contactors. This linkage closes the contactor until the knee joint pushes against the trip control lever when the knee



bends and opens the contactor. By changing the position of the trip control lever, the period of the welding stroke, during which the current flows, and the amount of contact are determined.

High-Speed Tractor Has Many Uses

The Model "IB" industrial tractor, recently introduced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis., weighs 2140 lb. and develops 13.5 drawbar hp., is designed to speed-up hauling operations. It has three forward speeds and a reverse, sets low on the ground, and has the stability to haul up and down inclined ramps without tipping. A

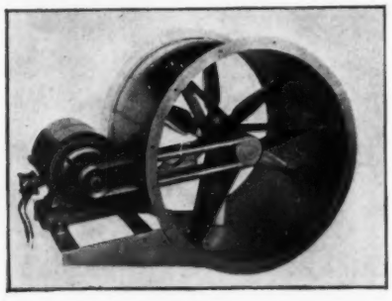


foot brake and individual hand brakes on the rear wheels facilitate maneuvering in cramped quarters. It has a muffler and foot accelerator, and can be equipped with numerous accessories, such as power take-off, belt pulley, generator, lights and wheel weights.

Fan Unit Designed For Duct Line Use

South Bend Air Products, Inc., 322 E. Colfax Ave., South Bend, Ind., has announced a fan unit designed primarily for use in duct systems, and having a number of advantages, especially where explosive gases are to be handled.

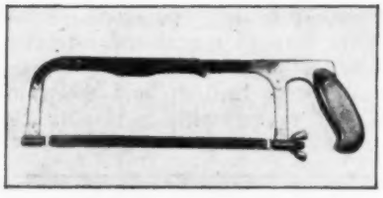
Designed for static pressure up to



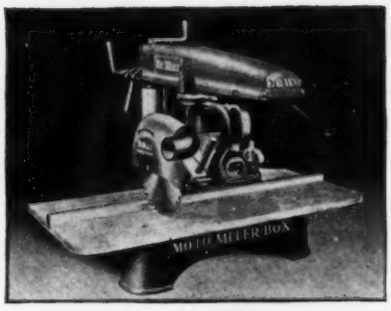
3 in., it is furnished in both single-fan and tandem-fan types. Capacities of single-fan units range from 1,600 to 26,000 cu. ft. per min., while those of tandem units range from 1,600 to 30,000 cu. ft. per min. Blades are of drop forged aluminum alloy, and entire unit is non-sparking for safety in explosive atmospheres.

Bonney Hacksaw Frames Made for Hard Service

The No. 2628 hacksaw frame announced by Bonney Forge & Tool Works, Allentown, Pa., is adjustable



and will accommodate blades from 8 to 12 in. long. Blades may be faced in four directions. The checkered steel pistol grip fits comfortably in the hand. A full line of 10 to 12 in. blades in coarse, medium and fine series made of tungsten alloy steel with flexible back and hardened teeth also have been made available.

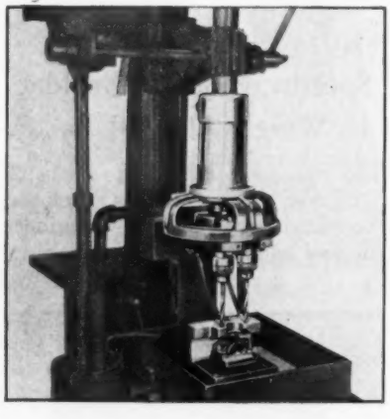


Woodworking Saw Fully Adjustable

A woodworking tool which performs 29 different operations is offered by DeWalt Products Corporation of Lancaster, Pa. The tool, known as the "Moto Miter Box," is intended for light cutting in small shipping departments, and in carpenter, pattern and cabinet shops. It cuts off 2 in. stock. The direct-drive motor runs from an ordinary light socket. The arbor can be placed in any position for all sawing operations.

Linderme Drill Head Has Adjustable Spindles

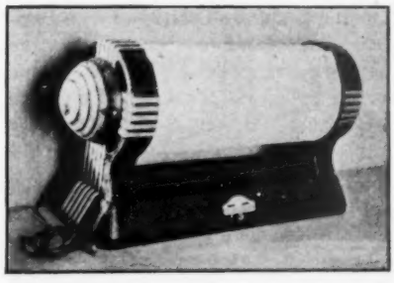
The Linderme Machine & Tool Co., Inc., 12239 Coyle Ave., Detroit, Mich., has developed a two-spindle quick-set adjustable drill head in



which the drill center can be adjusted from $\frac{7}{8}$ to 6 in. simply by turning two hexagon nuts. This drill head is especially suited for small sensitive drill presses, and can be used for tapping operations.

"Minute Man" Machine Makes Prints Faster

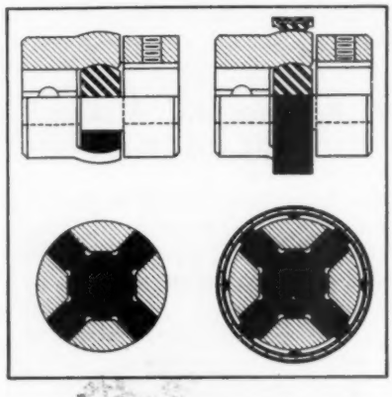
Designed to be of practical use in the small office, as well as for large engineering department, the "Minute Man" blueprint machine offered by the Paramount Engineering Co., 5707 West Lake St., Chicago, Ill., is said to make perfect blueprints in one minute or less. Occupying a desk space of 26 x 9 in., it makes prints in any size up to 18 x 24 in. The original and the sensitized paper are wrapped around an 8-in diameter glass cylinder and held in place by a heavy can-



vas cover. Two photoflood bulbs inside the cylinder are controlled by a "Mark Time" timer to insure proper exposure. Low operating and maintenance cost and simplicity of operation are said to make it an effective piece of equipment.

Flexible Coupling Has Steel Binding Ring

Two flexible couplings using rubber or Neoprene inserts have been made available by Certified Flexible Couplings, Inc., 122 E. 42nd St., New York, N. Y. The standard No. 4 coupling, shown at the left, is similar in every way to the smaller couplings previously available, ex-



cept that this coupling can accommodate shafts up to $1\frac{1}{4}$ in. in diameter. The No. 4R coupling, shown at the right, incorporates the same end castings as used for the standard No. 4 coupling, but it differs in that the rubber or Neoprene insert has a steel ring molded into extensions of the lugs, thereby

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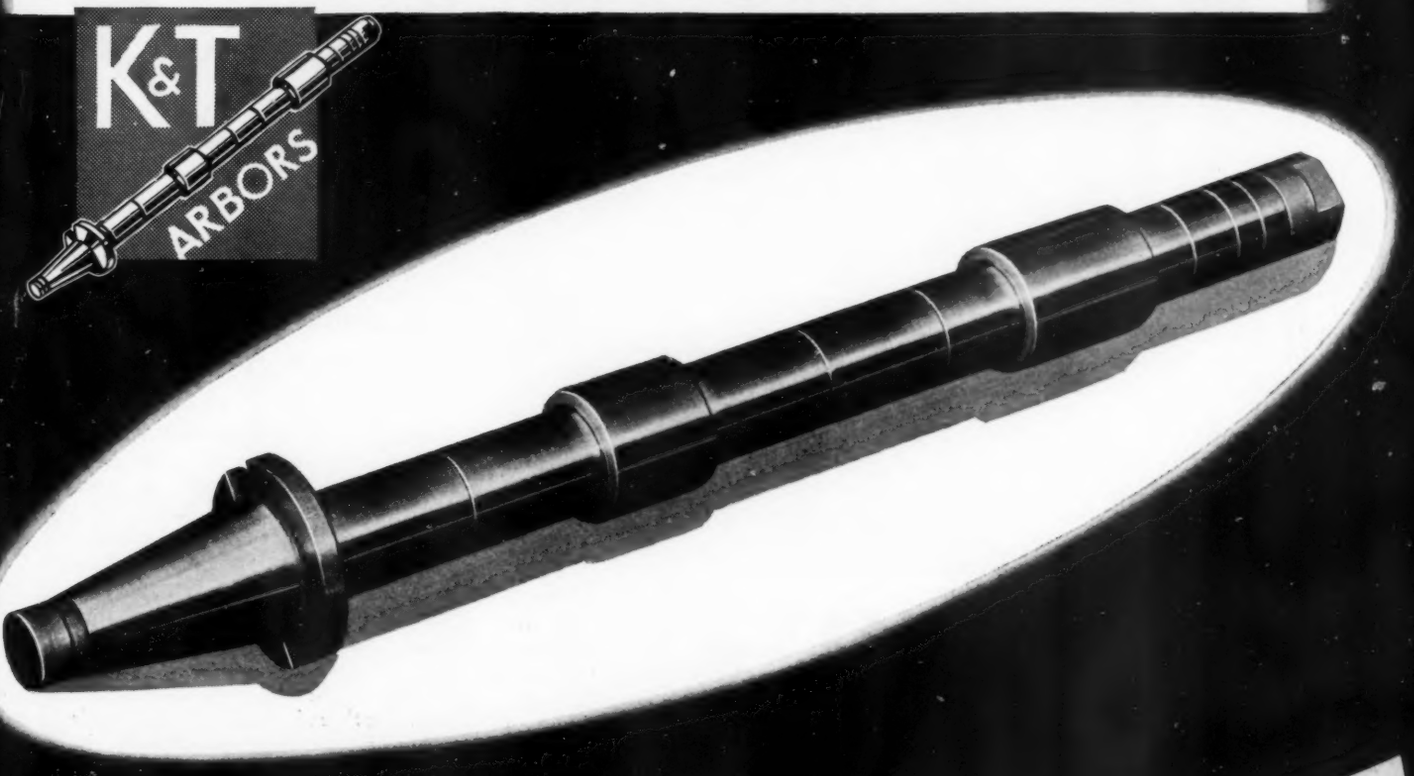

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inclosing the rubber into a compression chamber. This type R coupling will carry higher torques than the standard design.

Hand Numbering Tool Offered by Bates

This non-automatic, hand numbering tool developed by H. O. Bates, 251-257 N. Broad St., Elizabeth, N. J., is intended for stamping unhardened steel and other metals by use of a hammer or rawhide mallet. Standard sizes of the six number wheels are

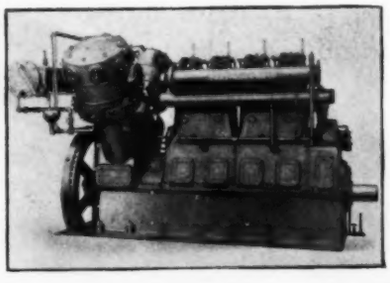
$\frac{1}{32}$, $\frac{3}{64}$, $\frac{1}{16}$, $\frac{5}{64}$, $\frac{3}{32}$, $\frac{7}{64}$ and $\frac{1}{8}$ in. Letters can be provided instead of numbers on any of the wheels. A hook is furnished for turning the wheels, but they also can be turned with the fingers. This tool also can be used in a press for machine numbering.

Small "Multi-Breaker" Handles Light Loads

The 15-, 20-, or 25-amp. Type MO "Multi-Breaker," announced by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., has been designed to provide low-cost circuit breaker protection on circuits supplying comparatively light loads. The unit measures 6 x 4 x $2\frac{7}{8}$ in., and is furnished for one or two single poles, grounded or solid neutral; for three-wire solid neutral 115-230-volt a.c., one double pole or two single poles, grounded or solid neutral, or for two-pole, 115-230-volt, a.c., one double pole, no neutral. Indicating handle shows whether breaker is on, off, or tripped, and breaker cannot be held closed on a short circuit or overload.

V-Type Compressors Diesel-Operated

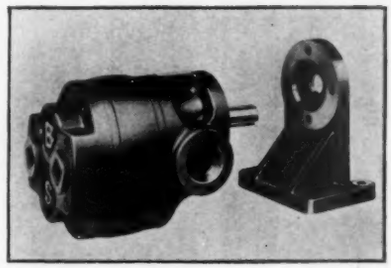
Double-acting V-type water-cooled compressors on a common crankshaft and base with a heavy-duty diesel engine have been made available in capacities of 662 to 2,000 cu.ft. per min. at pressures of 80 to 125 lb. per sq.in. by the Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y. The engine is of medium-speed full-diesel type with Bosch direct injection, including an individual fuel pump on each cylinder.



The compressors have crosshead guides bored in line with cylinder centers. Automatic three-step capacity regulation is available on all sizes, while five-step regulation can be furnished for the larger sizes. Unloading is accomplished by holding open the inlet valves in successive steps.

B. & S. Geared Pumps Use Herringbone Gears

The Series 500 rotary geared pumps, announced by Brown & Sharpe Mfg. Co., Providence, R. I., incorporate heat-treated herringbone gears, and are made in six sizes with capacities ranging from 5 to 36 gal. per min. at pressures up to 500 lb. per sq. in. These pumps are said to run quietly at high speeds and can be direct motor driven. A foot-type mounting bracket makes these pumps adaptable for duplex and motor-drive units. Pumps have needle bearings and moving parts are hydraulically balanced for end thrust. A double self-balancing seal is used in all except the smaller sizes. The pumps are unidirectional, but a reversible back drain allows the direction of rotation of the pump to be changed easily for mounting convenience.



National Cable Clamp Easy to Assemble

The "Safe-Line" wire rope or cable clamp offered by National Production Co., 4561-4603 St. Jean Ave., Detroit, Mich., is made in stock sizes for ropes ranging from $\frac{1}{8}$ to $\frac{3}{4}$ in. in diameter. The inner surface of the clamp which grips the wire rope, is double spiral splined to fit each strand and wire of the rope, thus making a secure grip on each section. The gripping halves of the clamp are held tightly to the rope by taper threaded nuts. A joint made with one of these clamps can be readjusted quickly to the proper tension. Consisting of but four parts, the clamp unit is easy to assemble; no special tools are required.

Pipes and Tubes Joined with "VibraSeal"

Requiring no special tools for installation, the "VibraSeal" pipe and tube connections offered by VibraSeal Corp,. 2832 E. Grand Blvd., Detroit, Mich., require no flaring, make a leak-proof connection, and are claimed to protect against vibratory strains, tube fatigue and failures. These connections are suitable for gas, fuel oil, air and refrigerant gas connections. "VibraSeal" connections are suitable for copper, aluminum and

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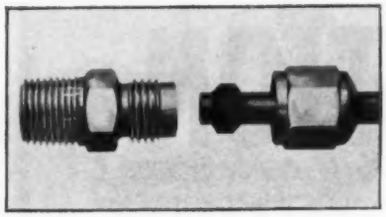
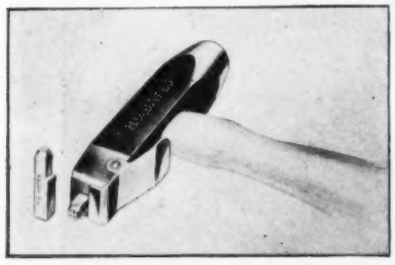


steel tubing and consist of an adapter, shown at the left, a gasket, and a lock nut which swedges the gasket into the tubing by compression. They are made for low pressure, high pressure, aircraft and special applications and are available for tubes of $\frac{1}{8}$ to 2 in. outside diameters.

Hammer Combines Holder and Stamp

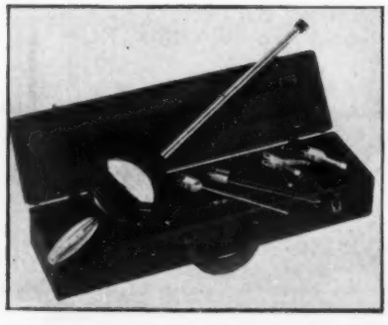
The "Hercules" holder principle has been combined with the hammer stamp in the "Hercules" inspectors' hammer made available by H. O. Bates, 251-257 North Broad St., Elizabeth, N. J. Use of an improved shoulder style of interchangeable type



permits rapid selection of any character. The hammer is constructed of a shock-resisting alloy steel, hardened and drawn to insure long service. A type holder at each end of the hammer can be furnished if desired, and larger hammer stamps which take more than one piece of type also are available.

Wheelco Pyrometer Reads Surface Temperatures

The Series 2850 surface temperature pyrometer announced by Wheelco Instruments Co., 1929–1933 S. Halsted St., Chicago, Ill., is light in weight and will measure temperatures up to 1,200 F. Interchangeable thermocouples are available for different applications. Handle may be screwed on either the bottom or back of the instrument, according to the convenience of the operator. The flexible, adjustable joint which holds the thermocouple to the handle can be swung through 180 deg. Automatic cold junction compensation is provided.



Quirk Batteries Used in Flashlights

The "Charg-O-Matic" small portable storage cell battery offered by the Quirk Battery Co., Highland Park, Ill., is designed especially for flashlight and similar uses. This miniature battery is a true storage cell, but is made to fit standard flashlight cases in which two ordinary $1\frac{1}{2}$ in. size D dry cells are used. A small unit is provided to recharge these cells. It operates on 110-120-volt, 60 cycle, a.c. current. The transparent Lucite case makes it possible to tell when the battery liquid needs replenishing with distilled water.

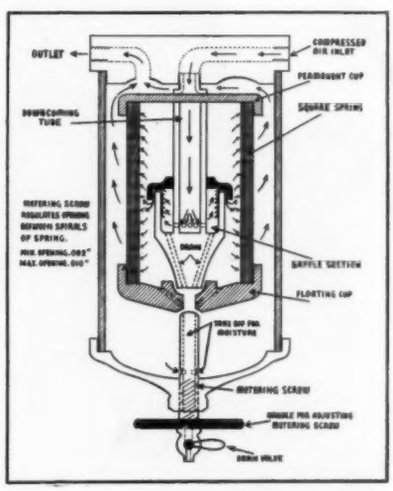
Hall "Binracks" Can Be Stacked

"Binrack" stacking units for storerooms or assembly benches have separately removable gravity-feed till-type bins. Made by the Gordon L. Hall Co., Old Lyme, Conn., these units are made in two styles to accommodate seven sizes of standard and hopper bins varying in capacity from $\frac{1}{2}$ to 6 pints each. Any size bin will fit in its rack in any position, and the stacking rack units can be arranged to suit the work place or storage conditions. Rack units are made in 8- and 12-in.

lengths, so that combined rack lengths can be varied in any multiple of 4 in. Units are 8 in. deep and 7 in. high.

"Stevens" Separator Has Spring Filter

Positive filtration is effected in the "Stevens" Model B-12 moisture separator developed by the Master Metal Spray Co., 2527 Magnolia St., Oakland, Calif., by efficient design of the baffling, together with edge-pressed coils of the square spring. Area



through the coils is regulated by a metering screw and ranges from 0.002 to 0.010 in. Capacity of the unit is 120 cu. ft. of air per min. at 100 lb. pressure.

Wear-Resisting Parts Made from Kennametal

McKenna Metals Co., 103 Lloyd Ave., Latrobe, Penna., has announced that Kennametal now is available in almost any desired shape for use in parts subject to unusual wear or for gages which must hold their accuracy.

Kennametal, which also is being used for tipping cutting tools, contains tungsten-titanium carbide. It is used for making extrusion dies for coating steel welding rods with abrasive flux, for dies made for pressing articles of refractory aluminus oxide, and for plug gages, as well as for lathe and grinder center nibs, jig bushings, sandblast nozzles, and other wear-resisting parts.

Portable Hand Cleaners Have Safety Improvements

Improvements now incorporated in the line of portable hand-vacuum cleaners, offered by Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill., include a three-wire ground cable and a protective mesh screen for the motor commutator. The three-wire cable, which is permanently attached to the blower handle, uses the third wire as a ground on the handle casing to protect the operator from shocks caused by shorts due to weather, excessive moisture, oil accumulation and accidental contact with "live" parts. The provision of a fine-mesh wire screen which covers the commutator end of the motor housing and prevents the entrance of excessive dust and dirt also protects the operator should any minor explosion occur inside the housing due to commutator sparking.

Grinding Wheel Bushing Dampens Vibration

The vibration dampener bushing resilient mounting for portable grinders is a feature being incorporated in grinding wheels manufactured by the Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc., Passaic, N. J. Tests indicate that use of this new mounting, which requires no changes in the use of equipment, increases grinding wheel life. Machine maintenance costs are said to be greatly reduced, and a better grinding finish is obtained.

Fansteel "Tantung" For Hard Facing

"Tantung," a hard facing material placed on the market by the Fansteel Metallurgical Corp., North Chicago, Ill., in the form of welding rods and castings, consists chiefly of tantalum and tungsten and has wear resistant properties that are said to be as much as 5 to 20 times that of hardened steel. Its acid and corrosion resistance is high, as is its "red hardness." It can be used for making cutting tools by simply depositing it on the end of an inexpensive steel shank and then grinding it to shape. It is a tough material, and hence can be used on shapers, planers and similar machines for interrupted cuts. This material is easily applied to iron or steel parts with an oxyacetylene torch. A highly carbonizing flame is used to melt the rod onto the part in question. The part must be preheated to a sweating heat in a gas furnace or with the torch, and a special flux is used to coat the welding rod.

Goodrich Diffuser Lights Without Glare

The "Protecto" diffuser announced by the Goodrich Electric Co., 290 N. Oakley Ave., Chicago, Ill., is made especially for illuminating areas where precision operations require continuous good vision. This fixture is said to provide high intensity lighting without glare. It has a deep-skirted reflector, while the globe is small in size and is concealed high above the bottom of the reflector skirt. These units are avail-

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able with a "Diskonect" hood which permits instant release of the reflector, globe and lamp as a complete unit, without using tools or disturbing the wiring.

Jefferson Transformers Used for Mercury Lamps

Two additional types of transformers, each designed to operate two 400-watt mercury lamps, have been announced by the Jefferson Electric Co., Bellwood, Ill. The indoor type is rectangular in shape, arranged for wall post mounting with brackets for easy installation, and with terminals made accessible by means of small doors at top and bottom. The weatherproof pole mounting transformers have terminals accessible at the bottom and three threaded hubs so that up to three fixture mounting supports may be used.

Westinghouse Offers Heat-Treated Gears

A complete line of heat-treated gears for heavy-duty industrial applications has been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These gears, heat-treated by the Barnes (BP) process are offered for use where long life and dependability under adverse operating conditions are required. Heat-treatment by the BP method gives the gears a hard wearing surface, tapering off on the inside to an extremely tough core. Gears in this line are claimed to have approximately four times the life of an untreated gear or pinion under the same service and operating conditions. Rate of wear is nearly constant throughout the useful life of the gear.

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There's a lot of good, practical, common sense behind the design of Lufkin Radius Gages. For example, each blade carries the corresponding external and internal forms, and because each blade is a separate unit, it alone can be applied to the work. Each blade has five different applications. All blades are packed in a durable leatherette folder and are sold in five different sets. Radii range from 1/32" to 1 inch. Write for complete catalog 12A.

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TAPES — RULES — PRECISION TOOLS

Resistor Operates Fluorescent Lamps

A "Vitrohm" resistor for the operation of fluorescent lamps on direct current has been developed by Ward Leonard Electric Co., Mount Vernon, N. Y. These units, mounted in a small perforated metal inclosure, are designed in accordance with the specifications of lamp manufacturers. Long flexible leads facilitate connecting the units when mounted in any standard fixture, wiring trough or channel. Units for lamps of 15, 20, 30 and 40 watts are available.

G.E. Ballast Used for Fluorescent Lamps

An improved ballast for use with fluorescent Mazda lamps has been announced by General Electric Co., Schenectady, N. Y. The lamp starter or switch has been removed from the ballast, permitting it to be mounted easily in another part of the circuit, and making it accessible from the outside of the fixture. This ballast, designed for use on a.c. circuits, will operate two lamps. Also, a ballast for use with fluorescent lamps operated from d.c. circuits has been made available.

New Chemical Cartridges Are Interchangeable

The American Optical Co., Southbridge, Mass., has announced the development of three chemical cartridges which are quickly and easily interchangeable with the standard Type A dust cartridge now being supplied for the American R1000 respirator. One of the new chemical cartridges is designed for use against low concentrations of fumes and

gases encountered in paint spraying, and other light organic vapors. If desired, a protective cover can be supplied to retard plugging when the respirator is used in paint spraying. The second cartridge can be used against low concentrations of acid gases, and the third against low concentrations of acid organic gases.

TRADE PUBLICATIONS

BUFFING The Division of Simplified Practice of the National Bureau of Standards has announced that the Simplified Practice Recommendation No. R-115-30, full disk buffing wheels, has been reaffirmed without change by the standing committee of the industry. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. for five cents each.

CLUTCHES A four-page leaflet published by Dawes Equipment, Inc., 2280 Penobscot Bldg., Detroit, Mich., describes the construction and applications of the new "D-E" automatic centrifugal clutch.

ILLIUM Physical and chemical properties of Illium, a corrosion-resistant alloy manufactured by the Burgess-Parr Co., Freeport, Ill., are provided in a 6-page bulletin, No. 103.

INSPECTED EQUIPMENT Underwriters' Laboratories, Inc., 207 E. Ohio St., Chicago, Ill., has published a July, 1939, supplement to its January, 1939 list of Inspected Fire Protection Equipment and Materials.

MATERIALS HANDLING Bulletin No. 105, issued by the Robins Conveying Belt Co., 15 Park Row, New York, N. Y. describes the Styles H and J "Vibrex" screens.

MOTOR PROTECTION The "Thermoguard," a device for protecting fractional-horsepower motors against burnout, is discussed in Booklet F-8490, released by Dept. 7-N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS Dept. 7-N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., discusses features of a line of fractional-horsepower capacitor motors in Folder No. F-8485.

PLATING Technical Service Manual No. A-220, issued by the Electroplating Div., E. I. du Pont de Nemours & Co., Wilmington, Del., discusses the use of "Cadalyte" bright dip for improved cadmium-plated surfaces.

POWER TRANSMISSION Engineering and design data on round pin roller chains and other types of power transmission chain and accessories are provided in a 12-page illustrated bulletin, No. 45, published by the Morse Chain Co., Ithaca, N. Y.

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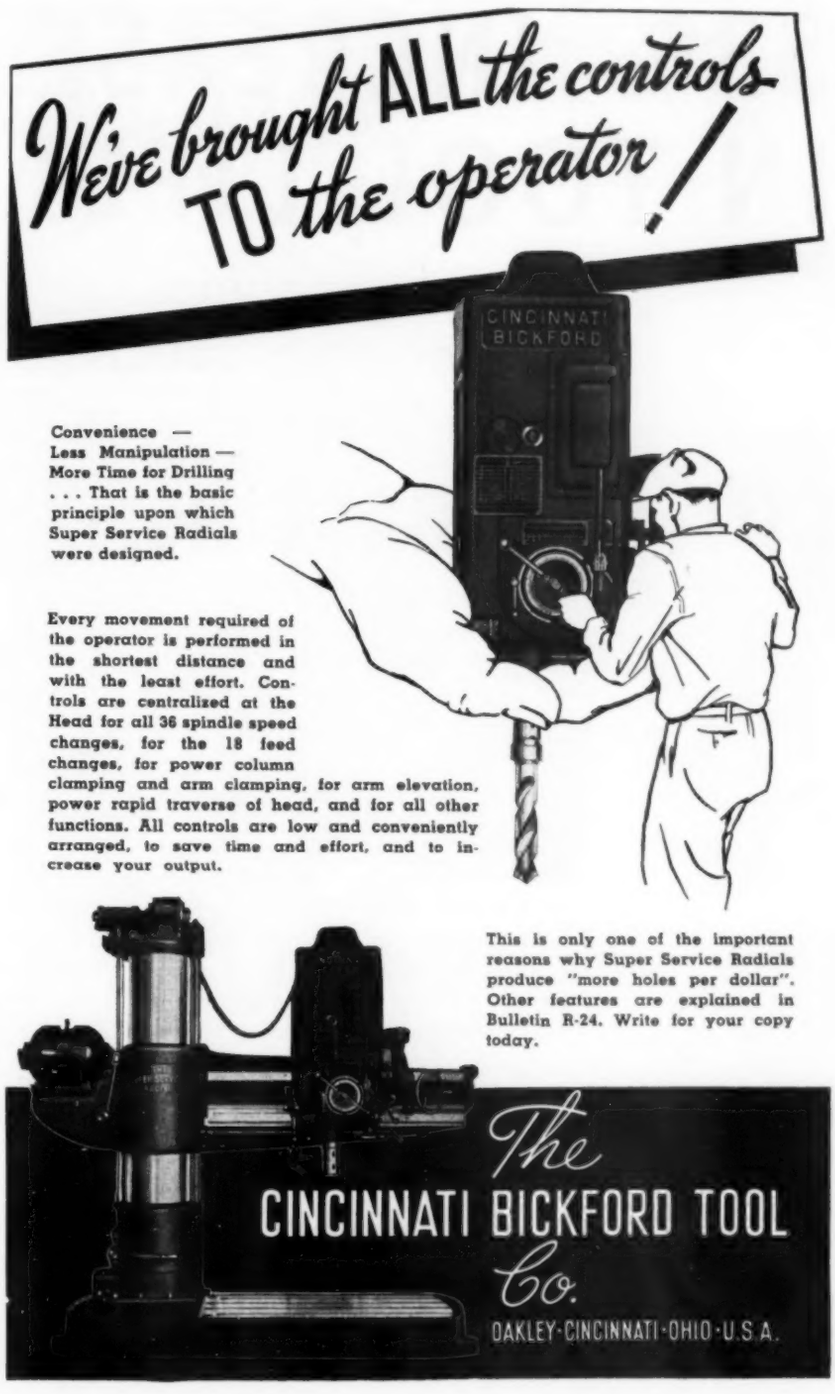
REDUCERS The Type SME straight-in-line "Ratiomotor" is described in data folder No. 8602 published by Boston Gear Works, Inc., North Quincy, Mass.

SAFETY "Eyes are Expensive Targets," a 16-page booklet published by the American Optical Co., Southbridge, Mass., contains much information concerning the cost and causes of eye accidents, and valuable suggestions for reducing them.

STEEL INDUSTRY Bureau of Mines, U. S. Department of the Interior, has made available its economic paper No. 19, entitled "The Iron and Steel Industries of Europe." For sale by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the Superintendent of Documents, Washington, D. C., at 20 cents per copy, this volume contains 98 pages of discussions, maps and other statistical information concerning the European iron and steel industry.

STEEL STAMPS Features of a line of "Safety" steel stamps and holders are provided in an illustrated leaflet issued by M. E. Cunningham Co., 115–117 E. Carson St., Pittsburgh, Pa.

"SUPER-CENTRIFUGES" A 20-page illustrated catalog now being distributed by the Sharples Corp., 2336 W. Moreland St., Philadelphia, Pa., discusses the principles of operation, construction and applications of various models of the "Super-Centrifuge."

"THERMOVERTER" Bristol Co., Waterbury, Conn., describes in Bulletin No. 533 the "Thermoverter" for a.c. electrical power measurement with millivoltmeters.

TRANSFORMER The Pittsburgh works of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued Leaflet No. B6007, describing small autotransformers for supplying electric tools, lights and other appliances with 120 volts from a 240-volt supply line.

TRANSFORMERS Bulletin No. GEA-3085A, published by the General Electric Co., Schenectady, N. Y., discusses features and provides specifications of "Spirakore" single-phase oil-immersed distribution transformers.

TURRET LATHES Additional examples of turret lathe performance are provided in Data Sheets Nos. 26, 27, 28 and 29, distributed by Gisholt Machine Co., 1201 E. Washington Ave., Madison, Wis.

VISE A leaflet issued by Fray-Mershon, Inc., Glendale, Calif., describes the "Defiance" line of stationary- and swivel-base vises.

WELDERS Bulletin No. W-26, offered by the Harnischfeger Corp., 440 W. National Ave., Milwaukee, Wis., describes the new P & H Hansen Model WA-200 square frame arc welder.

WORM GEARS Illustrations of various applications of worm gears for power transmission in many industries are included in a 16-page booklet, No. E-1175, released by the De Laval Steam Turbine Co., Trenton, N. J.

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NEW BOOKS

LUBRICANTS AND LUBRICATION—*By James I. Clower, associate professor of machine design, Virginia Polytechnic Institute, formerly technical editor, Vacuum Oil Company. 464 pages, 6 x 9 in. Indexed and illustrated. Clothboard binding. Published by McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. Price $5.00.*

The first ten chapters of this comprehensive book on lubricants and lubrication are devoted to a discussion of the production and testing of lubricants, and to the fundamentals of lubrication, lubricating appliances, systems and purification methods. Later chapters discuss the lubrication of specific types of apparatus. The final chapter is given over to a discussion of methods for properly storing and handling lubricants.

Convenient tables and charts in the text and in the appendix will be useful in the day-to-day application of the various lubricating mediums, while sketches of typical appliances

and lubricating systems aid in explaining their construction, operation and maintenance.

It is the author's opinion that in order to select, apply, use and care for lubricants properly, it is necessary to possess at least a fair knowledge of the source, production, refining and theory of lubrication. These subjects are discussed at some length, although certain specialized phases of the subject have been purposely avoided or minimized since the production and refining of crude oil, and the mathematical theory of lubrication, for example, are fully covered by other texts.

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APPLIED ECONOMICS FOR ENGINEERS—*By Bernard Lester, Westinghouse Electric & Mfg. Company, 464 pages, 6 x 9 in. Indexed and illustrated. Clothboard binding. Published by John Wiley & Son, 440 Fourth Ave., New York, N. Y. Price, $4.00.*

This book has been written especially to provide the student in engineering with an introduction to the practical aspects of economics, based upon conditions and problems which he is likely to encounter in practice. Although economic laws are fundamental and established, their applications is continually altering. The graduate entering the fields of engineer, industry and trade should understand their changing application.

Although written especially for young engineers, this text should be of value to industrial men who desire a better grasp of how fundamental economic principles are applied to current engineering problems. Tables and charts are used throughout the book to illustrate specific examples of the problems discussed.

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OPERATION ANALYSIS—*By Harold B. Maynard, president, Methods Engineering Council, and G. J. Stegemerten, staff supervisor, Time Study and Methods Department, Westinghouse Electric & Mfg. Company. 298 pages, 6 x 9 in. Indexed and illustrated. Clothboard binding. Published by McGraw-Hill Book Co., 330 West 42nd St., New York, N. Y. Price, $3.00.*

An essential part of scientific management, methods engineering offers a logical and systematic procedure for reducing costs, increasing production and improving quality. It may be applied with equal success to repetitive work or to operations less frequently performed. The principles upon which methods engineering is based are applied throughout the manufacturing industries and also have found applications in other enterprises.

Operation analysis is an essential part of methods engineering. In this book the authors present practical methods which may be applied by manufacturing supervisors to analyze operations and determine procedures that are more efficient, economical and easy to perform. Application of this method is inexpensive in comparison with the purchase of new equipment and once started it usually pays for itself many times over. Numerous examples are used to illustrate the principles discussed.

The procedure itself was developed by the authors to make the process of operation analysis a specific, systematic procedure which would give results in the form of methods improvement. In addition to direct analysis of manufacturing operations, the improvements possible because of better design and arrangement of tools and equipment, materials handling and plant layout are discussed.

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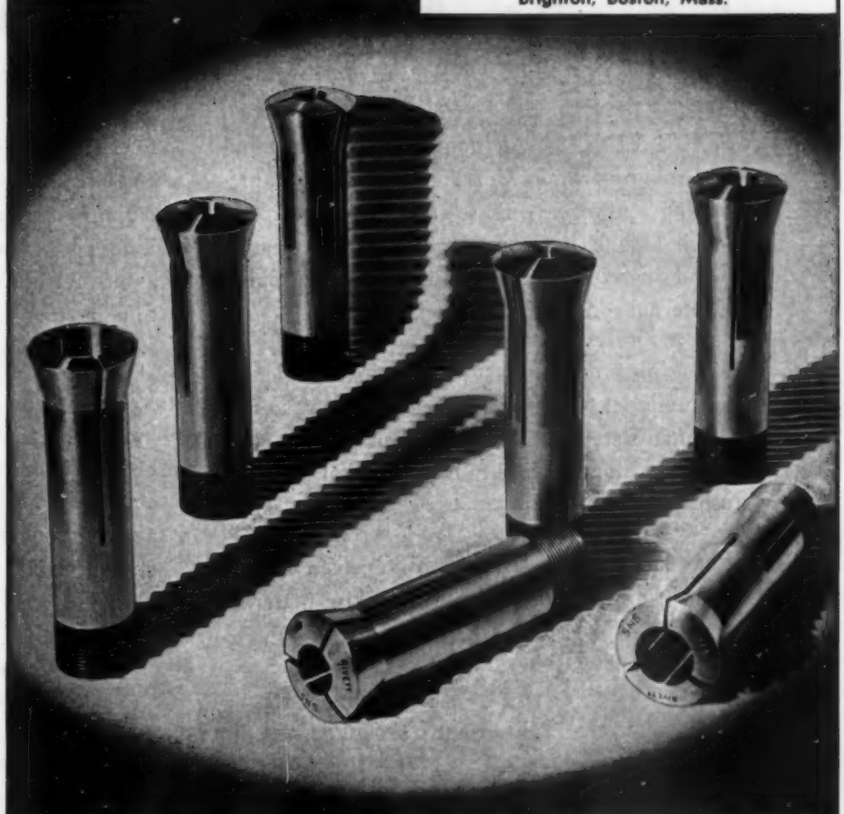

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